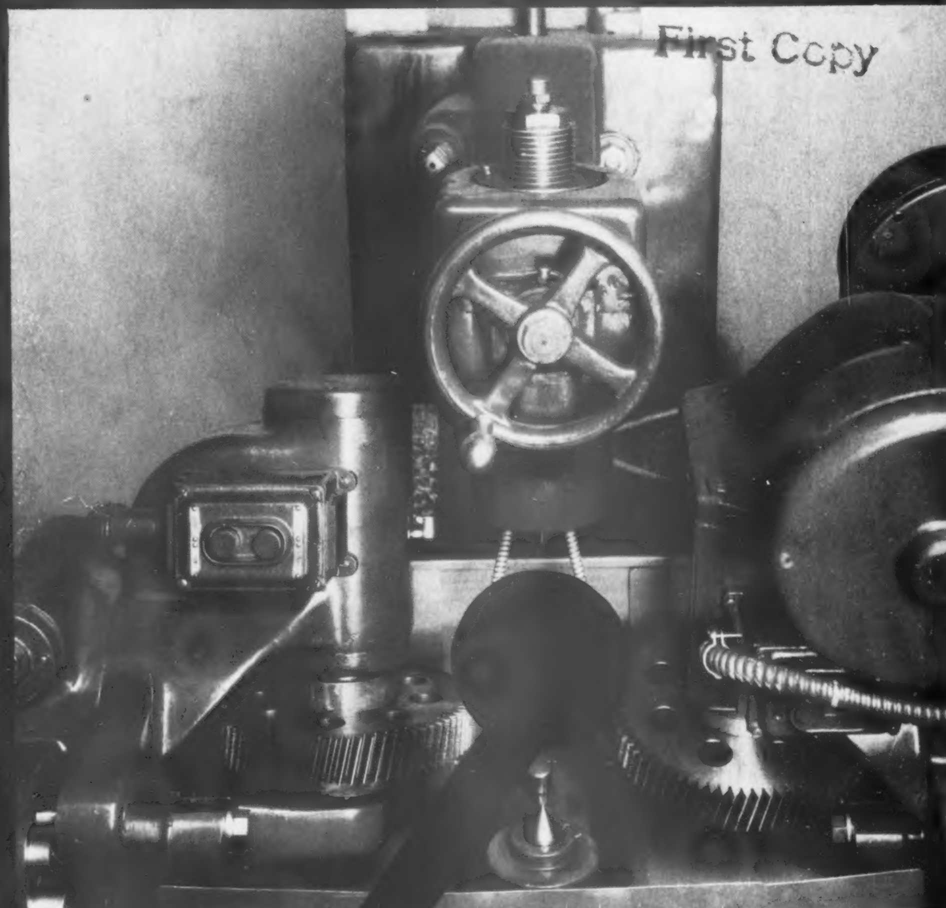
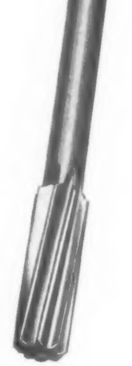
The Tool Engineer



ASTE

Every reamed hole in these cylinder cases for twin radial aircraft engines was roughed and finished with P&W "Blue Helix" Reamers.

"BLUE HELIX" REAMERS



These new chucking reamers are made of specially treated high speed steel. They are made with right-hand spiral flutes and are listed in decimal sizes. They are freer cutting as compared with straight or left-hand spiral fluted reamers, and produce cleaner, smoother and more accurate holes. They also have an increased life due to their design and their special P&W hardening treatment.

"Blue Helix" Reamers have been under test for two years in a number of large shops throughout the country. The completely favorable reports from these shops have proved the great superiority of these new reamers. In some cases they have produced more than double the tool life of ordinary reamers.

Write for a copy of our new circular, just off the press, containing complete information and size listings of these new reamers. It is free to any interested executive.

Reaming holes in a controllable-pitch propeller bracket made of high alloy 315 Brinnell steel, using "Blue Helix" Reamers. The tolerance is less than one half-thousandth. Notice the long, slender curling chips—ample evidence of the keen, shear cutting action of these tools.

PRATT & WHITNEY DIV.

Niles - Bement - Pond Company

HARTFORD • CONN • U. S. A.

Branch Offices and Agencies:—BIRMINGHAM BOSTON CHICAGO CINCINNATI CLEVELAND DETROIT LOS ANGELES NEW YORK PHILADELPHIA PITTSBURGH ROCHESTER SAN FRANCISCO ST. LOUIS

The Tool Engineer

Trademark Registered in U.S. Pat. Off.

Official Publication of the AMERICAN SOCIETY OF TOOL ENGINEERS

Vol. V JANUARY, 1937 No. 9

Contents This Issue

Application blanks and information pertaining to membership in the American Society of Tool Engineers may be had by addressing **The Tool Engineer,** 2842 W. Grand Boulevard, Detroit, Michigan, or the Secretary's office, 5928 Second Blvd., Detroit, Michigan. **Dues** are $5 initiation fee, $6 per year for senior grade membership and $3 per year for junior grade membership. Junior membership initiation fee $2.

The Tool Engineer is published on the first Thursday of each month. It is the official publication of the American Society of Tool Engineers, Incorporated. The membership of the Society and readers of this publication are practical manufacturing executives such as master mechanics, works managers, Tool Engineers, tool designers and others who are responsible for production in mass manufacturing plants throughout the nation and in some foreign countries.

Owing to the nature of the American Society of Tool Engineers organization, it cannot, nor can the publishers be responsible for statements appearing in this publication either as papers presented at its meetings or the discussion of such papers printed herein.

Published by
THE BRAMSON PUBLISHING CO.
2842 W. Grand Boulevard MAdison 7553 Detroit, Michigan
Roy T. Bramson, Publisher and Editor

ADVERTISING OFFICES:

Chicago, Illinois
Dwight H. Early
100 N. LaSalle Street
CENtral 4158

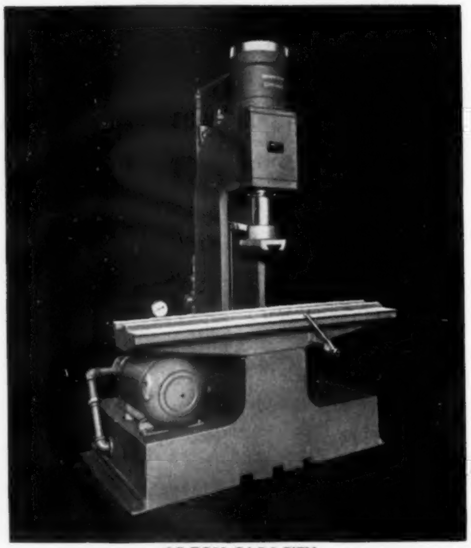
Providence, R. I.
H. T. Pierik
4 Weybosset Street
GAspee 1566

Printed in the United States of America

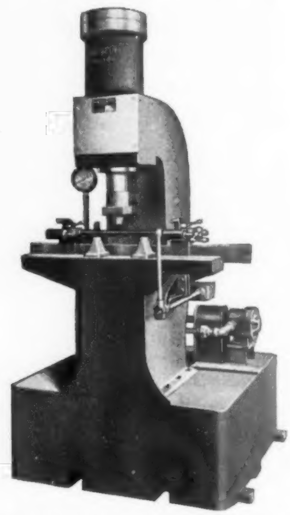
New Hydraulic

STRAIGHTENING PRESSES

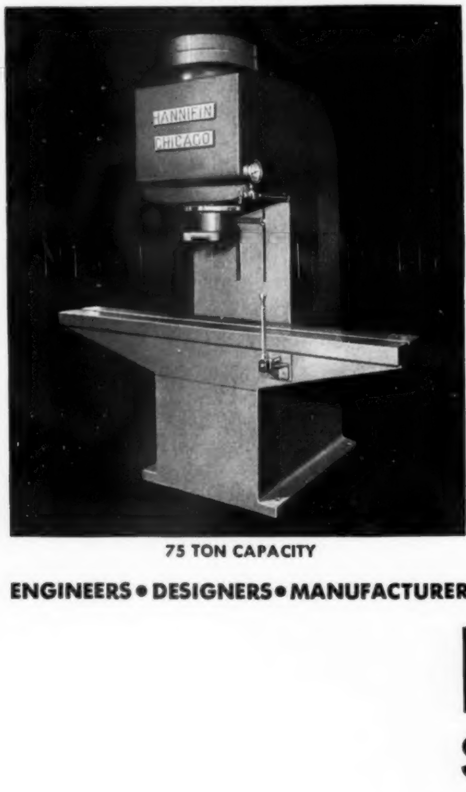
CAPACITIES: 20, 35, 75 TONS



35 TON CAPACITY



20 TON CAPACITY



75 TON CAPACITY

Single lever proportional control of these new Hannifin Hydraulic Straightening Presses greatly simplifies the handling of accurate straightening operations. When the control lever is moved in either direction the ram will move a proportional distance under full pressure, and then stop. Simultaneously the operating valve moves to neutral and the pump idles at zero pressure until another movement of the ram is required.

This exclusive design of the control allows extremely sensitive handling of the ram for accurate and rapid straightening work on axles, crankshafts, camshafts, airplane propellers, and any similar work. The control is so simple that the operator's full attention and skill may be devoted to accurate work.

An individual hydraulic power unit is built into the base of each press, requiring only electrical connections for installation. Other capacities are available, and any type of fixture may be installed, as required by individual operating conditions.

20 ton Hydraulic Straightening Press: Ram stroke 6 in. Table to ram (up) 8½ in. Center of ram to face of frame 7½ in. Table length 36 in. Overall height 81 in. Motor 10 h.p.

35 ton Hydraulic Straightening Press: Ram stroke 6 in. Table to ram (up) 20 in. Center of ram to face of frame 9 in. Table length 70 in. Height 98 in., base 38½ x 69 in. Motor 10 h.p.

75 ton Hydraulic Straightening Press: Ram stroke 12 in. Table to ram (up) 18 in. Center of ram to face of frame 10 in. Table length 84 in. Height 100 in., base 32 x 52 in. Motor 10 h.p.

Specifications may be modified to suit individual requirements, including any desired ram speeds

HANNIFIN MANUFACTURING COMPANY
621-631 South Kolmar Avenue, Chicago, Illinois
Detroit Office: Hayward Bldg., 4829 Woodward Ave., Tel. Columbia 4949. R. A. Bean, Mgr.

ENGINEERS • DESIGNERS • MANUFACTURERS • PNEUMATIC AND HYDRAULIC PRODUCTION TOOL EQUIPMENT

HANNIFIN

SPECIAL HYDRAULIC PRESSES

GEARING

C. RAY BRUNNER
CHRYSLER CORPORATION
TECHNICAL EDITOR
for this issue

GEARS -- AN INTRODUCTION

By A. E. RYLANDER

A LONG TIME AGO SOME genius conceived the idea of putting teeth on the periphery of a wheel, perhaps after an abortive experiment with friction drives. The idea was, presumably, to increase traction, like putting cleats or hobnails on shoes. Whether or not that was the way it happened doesn't matter; the fact is that somebody did put teeth on a wheel, and—from that beginning has been evolved not only an engineering science but an INDUSTRY of rather enormous proportions.

For gearing is a science, entailing its own mathematics and engineering; an industry with its own problems of production, tooling and gaging, and its own specialized machinery, the manufacture of which is an industry in itself. At risk of punning, it might be stated as an axiom that the gear is an essential COG in our modern civilization. We could have steam and electric power, and even two-cycle gas engines without gears, and even the automobile, although it would be hard to imagine it anything like the smooth product of today. But many other inventions, with their resultant vast industries, would never have seen fruition without gearing of some sort.

Twenty years ago men said that gear design had seen its ultimate, but the automobile gear gave new impetus to further developments and refinements, while chemical engineers and metallurgists provided better materials and improved methods of heat treating. So, we have comparatively rough cast gears for textile, mining and agricultural purposes, "good enough" cut gears for ordinary industrial use, the small but relatively coarse gears used in clocks, watches, and instruments, and the highly refined gears used in automobiles, aeroplanes, and for precision requirements.

Many volumes could be devoted to the subject of gearing alone. This issue, therefore, hits but a few of the high spots; these are, however, highly interesting and instructive. Mr. Ben Waterman, of Brown & Sharpe Manufacturing Company, is an authority on gears; incidentally, his firm has been a pioneer in gear development as well as in the design and manufacture of cutters and gear production machinery. They also manufacture gears on a large scale, and were among the first to produce automobile transmission gears.

The Michigan Tool Company has also developed some interesting methods of gear production, especially in generating processes, and the article by Mr. J. C. Drader will be found of great value. Other contributors are Mr. Douglas T. Hamilton of the Fellows Gear Shaper Company, whose discussion of Production Lapping of Gear Teeth is very enlightening, and the old reliable methods of "Gear Size Measurement" by Mr. Chesley of the Chrysler Corporation are practical, usable facts that the Tool Engineer wants and needs. In all, we feel that while more or less epitomized, the articles on gearing in this issue are a real contribution to this science.

PRODUCTION PERSPECTIVES

News of Mass Manufacturing from Everywhere

Wage increases, the many Christmas bonuses paid out last month, extra dividends, and continued industrial construction give clear evidence that 1937 will be a bang-up year for mass manufacturing. During December the aforementioned wage increases, bonuses, extra dividends, and industrial construction very nearly reached an all-time peak. Many points throughout the country reported employment and payroll totals exceeding those of 1929. The list of companies who paid extra disbursements to employees or stockholders or both was nothing short of spectacular. As the new year is begun, production facilities in many plants are heavily taxed. A serious phase of the otherwise encouraging and happy situation, is a marked shortage of skilled labor, due in large part to the fact that apprenticeships were curtailed or eliminated entirely in many plants during the depression. Realizing this condition, a number of manufacturers and several trade associations are now launching apprentice training systems.

New England

From the important Connecticut area we hear the **New Haven Clock Company,** New Haven, is **making extensive alterations** in one of its factory buildings and that the **former "Wheel Shop" plant in Guilford has also been purchased** by the company for future industrial use.... **A five-story addition** costing $74,000 and adding about 50,000 square feet of space will be erected by **Arrow-Hart & Hegeman Company, Hartford,** makers of electrical supplies.... **Risdon Manufacturing Company, Naugatuck,** has awarded contracts for an addition, as has the **Pequot Wire Company, Norwalk,** and **Scovill Manufacturing Company, Waterbury.... New Departure Division, General Motors Corporation, will spend** nearly $13,000 **for improvements at its main plant in Bristol....** Another addition has been started at the **Hamilton Standard Propellor Company plant in East Hartford,** supplementing the new main factory structure which is near completion. ... **Hendey Machine Company, Torrington,** has voted a dividend of 25 cents a share on its common stock as well as arrearages on its Class A preferred, and a week's pay as a Christmas bonus for employees.... **The Bullard Company** and **The Lacey Manufacturing Company,** Bridgeport, are among other Connecticut tool plants to announce special payments to employees, with Bullard also declaring a dividend for common stockholders.... **Edward & Company,** electrical products, New York City, is **preparing to move to Norwalk** where a **new building,** 180 x 300 feet, one story, is **being erected** for its use. There will also be an office building.... Production of **American Brass Company, Waterbury,** and the **Chase Brass & Copper Company** in the same city **is running at high levels,** according to recent statements.... **Superior Casting Company, South Norwalk,** which was organized a year ago, has negotiated for **purchase of the Meeker Foundry Company plant** in that city and will operate both.... **Gill Bros., Inc.,** has been **organized** in Thomaston **to build machinery and tools,** with **William, Frederick,** and **Charles Gill** as incorporators.... **Charles W. Plumb,** 62, purchasing agent and secretary of the Eagle Lock Company, Terryville, **died recently.**

Employment in metal working industries of Western Massachusetts shows further gains. **Production in the automotive lines has showed a gain** while **electrical manufacturers have maintained their previous advanced schedules.** Calls for more equipment for electrical transmission and gains in building activity are given as reasons for maintenance of former high production levels in these lines.... **L. S. Starrett Company,** of Athol, distributed a 5% bonus to employees. The distribution was based on wages for the six months' period, June 1 to December 1. From Worcester we hear that the **Norton Company** announced that all factory workers paid by the hour or piece or by shop incentive method and all others paid by the week and not by the incentive method, except department heads, will receive an increase in wages or weekly salary of approximately 5% if in the employ of the company on December 1.... A 5% hourly wage increase for the more than 400 employees of the **Van Norman Machine Tool Company, Springfield,** giving them approximately $30,000 more a year than formerly, was also announced. **James W. Scott,** vice-president and general manager of the company, stated that **numerous orders were being received** by the company for products in large lots and that a fair percentage of the **increase is found in export orders** principally from Russia, England, and Japan. **Whitinsville Machine Works,** manufacturers of textile machinery, employing 2700 men, and the **Whitinsville Spinning Ring Company,** employing 100 men in making parts for textile machinery, announced a 10% wage increase. The machine works said that the pay of salaried workers would be "adjusted" about the first of the year.... **Earl C. Hughes, assistant sales manager of** the **Norton** Company, Worcester, **has resigned** to become secretary of the **Bay State Abrasive Products Company,** Westboro, Massachusetts, it is reported. Mr. Hughes' resignation terminated 18 years' service with the Norton Company in sales capacities.... **Florence Stove Company of Gardner,** Massachusetts, is another manufacturer to give employees special bonuses.... **Contracts have been awarded for the erection of an addition** to the plant at Barbers Crossing, Worcester, **for the Norton Company.** The new structure will be one story of brick and steel.... **Porter-McLeod Machine Tool Company, Hatfield,** and the **Westfield Manufacturing Company, Westfield,** are other manufacturers to grant special disbursements to employees last month. The latter company is said to be the world's largest manufacturer of bicycles and it was only a few weeks ago that this company granted a pay increase. This company has had an exceptionally busy year and at one time during their rush season had over 1,000 employees engaged in production.

Production of machine tools has held up to an exceptionally high level for the **Jones & Lamson Machine Company of Springfield, Vermont,** the **Kingsbury Machine Tool Company of Keene, New Hampshire,** and the **Sullivan Machine Company at Claremont, New Hampshire. William P. McSkimmon,** president of the **Union Twist Drill Company, Athol,** Massachusetts, announced that his company would pay each worker a bonus equal to 5% of the total wages paid him in a twelve-month period.

Indiana

Indianapolis welcomed a new in-

(Continued on page 28)

GEARS for MACHINE TOOLS

By B. F. WATERMAN
Brown & Sharpe Manufacturing Co.
Providence, R. I.

To those of us whose experience has covered a long period, the marked improvement in the making of gears for machine tools is very noticeable.

As we look back at some of the old designs of machines we find they had a minimum of available speeds and feeds, using cone pulleys for the spindle and the feed, soft gears (cast iron perhaps) and speeds and feeds of so low a rate that very conventional gears (as compared to our present gears) could be used.

With the advent of high speed steel, a rather sharp increase of speed and feed was called for, and, in some cases, excessive speeds and feeds were provided because we did not know the limitations of high speed steel.

With the capabilities of high speed steel becoming known, a wide range of speeds and feeds were necessary; and to provide this, tumbler transmissions were provided for the speed changes of milling machines and the feed of lathes. Also, more pick-off gears were provided for the changes of speeds and feeds of other types of machines.

The Old and the New

At this time, with Tungsten Carbide and Stellite tools and cutters, much higher speeds and feeds and greater ranges are necessary to get full production from these tools on all kinds and grades of material. As many as 32 speeds and 32 feeds are furnished on some machines.

In the 1860's when the first backed-off rotary gear cutter was developed and became a regular product of manufacture, it might be said that it first became possible to produce correctly formed gear teeth. Then, in the 1880's when the first automatic gear cutters for the use of these cutters were developed and replaced the old hand machines, the real manufacture of gears began.

In these first days because of the generally slow speeds, a set of eight cutters for each pitch was considered satisfactory for all numbers of teeth, and even today, for many gears, these same cutters are used and fill the need.

On gears requiring greater refinement, special cutters for exact numbers of teeth were made and later these cutters had their form ground.

In the 1890's a new system or method . . . the Shaper-Generating Method . . . was developed which permitted cluster gears to be made, and these, the automobile industry at a later date used very generally.

In the late 1900's, the Hobbing Method grew rapidly, adding a new generating method of producing gear teeth.

In the last few years, gear tooth grinding is often, if not generally, made use of for machine tool gears. This grinding operation is done in two ways; that with formed wheels not unlike the first method outlined above; and with the straight sided wheel generating the shape from disks with bands or using a master gear and rack.

Methods Used by the Machine Tool Builder

In outlining the various methods given above, I do so because they are the prevalent methods now in use in most machine tool shops, although there may be others such as the shaper generating method of producing herringbone gears which are used on some machine tools.

All the above methods of producing gears may be considered finishing methods—at the same time, any of the gears might be improved by lapping, and this process is performed in several ways.

I have enumerated these various methods to point out that some machine tool manufacturers find it necessary, or rather desirable, to make use of all of them.

In the first case where slow speed gears are used, as in feed trains, then the stock rotary cutter can be used to advantage. Also, in the case of tumbler gears, cutters that can produce sharp or pointed teeth for easy engagement can be made when no other process can do this. Then too, the rotary cutter method is very adaptable for milling the many splined shafts of all sizes that are used. On faster speed gears, special cutters or the hobbing method with ground hobs is used; this last method gives a flexibility in the cutting not attained with the rotary cutter. Also, the hobbing operation gives great flexibility to the production of helical, spur or spiral gears and lends itself to gears preparatory to the grinding operation, as a hob can be used in four or more cutting positions.

In the case of cluster gears, of course, the method to use is the Shaper-Generating Method.

It might be said that the outline of the processes of cutting, given above, applies generally to what may be called the standard machines, or to the feed trains of the so-called high speed machines. On the high speed machines with spindle speed as high as 1800 R.P.M., ground gears are generally used.

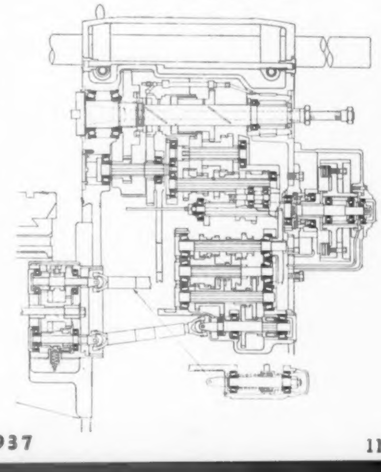
On these high speed gears, the grinding process is desirable as it is a very exact one, in that only a small amount of stock has to be removed from roughed out blanks that have been hardened and ground in hole and on the ends of the hub—each true and parallel with the other; all of these operations generally being simple ones even when splines are in the hole. The small amount of stock that can be and is removed at each pass of the wheel to prevent wheel wear enables the center distance to be maintained closely. The shape of the teeth is measured accurately within .0002". As to bevel gears, the spiral type is generally used for high speed gears, while for slower speeds, the conventional straight type serves the purpose.

The general quality of a pair of gears is tested on hand and power testing machines and also on charting machines.

Determining the Process

I have outlined the machines

(Continued on page 36)



PRODUCTION LAPPING of GEAR TEETH

By DOUGLAS T. HAMILTON
The Fellows Gear Shaper Company

Recent developments in gear finishing machines and tools have made possible the obtainment of more accurate gears "in the green." More effective and accurate means of inspection have also been instrumental in obtaining greater accuracy on a high production basis. Gears, however, for highspeed, heavy load applications must of necessity be heat treated or hardened, and while the hardening fire has been robbed of many of its terrors by better materials and improved methods of handling, errors due to distortion are still a constant source of trouble.

Finishing Gears After Hardening

There are two accepted methods for finishing gears after hardening—grinding and lapping. While grinding is the only practical method to employ where distortion is excessive, it is too costly for high-production work and is employed only where high cost is not prohibitive and for salvage. Lapping, however, is a comparatively inexpensive process and when the proper materials and suitable methods of handling in heat treatment are employed, gives satisfactory results. Lapping, however, should not be employed to correct errors resulting from inaccurate cutting—in fact, it is not primarily a material-removing process and is intended chiefly for smoothing the working surfaces of the teeth and correcting slight irregularities resulting from heat treatment.

Ordinarily, gears should not be lapped by rotation, because the only place that gears roll upon each other is on the pitch line and they slip at all other points. Therefore, when two gears are brought into mesh with a lapping compound introduced between the teeth, all of the lapping is done by one involute slipping over the other. If carried too far, the tooth shape is destroyed, because more lapping is done where the greatest slippage takes place.

Extensive experience has demonstrated that to be successful, the lapping operation must be under control, and only those methods which afford control prove satisfactory. It has also been found that a method which has proved satisfactory for lapping helical gears will not necessarily give equal success on spur gears.

Lapping External Helical Gears

A machine which has proved highly successful for lapping external helical gears is illustrated in Fig. 1. This employs three helical gear-type laps held at a fixed center distance and contacting the teeth of the gear at three points, thus expediting the lapping action.

The principle employed is to combine rotation and reciprocation of the work, which results in a criss-cross contact action of laps against the work. While this combined rotating and reciprocating motion is being transmitted to the work, the laps are acted upon by air brakes to offer resistance to their free rotation by the work. Hence, the teeth are kept in intimate contact on the driving side, thus effecting the lapping action. To lap the other side of the teeth, the direction of rotation of the work (which is the driver) is automatically reversed. Reversal of direction of rotation of the work is effected automatically by a reversing switch; whereas, the time of lapping is controlled by definite time relays.

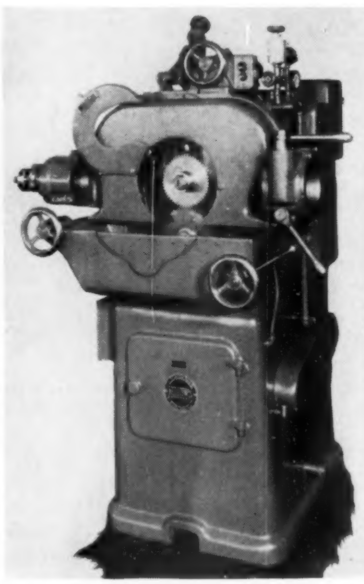


Fig. 1.—Fellows Automatic Gear Lapping Machine for Lapping External Helical Gears on a high production basis.

Fig. 2 illustrates diagrammatically the nature of the contact action between the laps and work when lapping external helical gears. The contacting action is progressive across the face of the gear starting in near the root of the tooth and traveling progressively to the top of the tooth, or vice versa, see A, Fig. 2.

This lapping principle employing three external helical gear-type laps is illustrated at B, Fig. 2. Here it will be noticed that when one lap is contacting the gear at the pitch line in one plane, the other two laps are contacting at different points in other planes; hence, lapping action is not localized. When the work is rotated and reciprocated, the contact action, which is at an angle to the pitch line element, is "swept" across the tooth. This scrubbing action expedites lapping and at the same time prevents destruction of the tooth shape. The rotary action helps to distribute the lapping compound.

Lapping Spur Gears

In lapping spur gears, a different method must be employed for the following reasons: when mating external spur gears are brought into mesh and rotated, pitch point contact is instantaneous, instead of progressive; hence, the teeth slip upon each other above and below the pitch line. Evidently, external spur gears cannot be successfully lapped by the same method as helical gears. "Rotary" slippage destroys rather than corrects the tooth shape.

Extensive research has developed a method for lapping spur gears, which is illustrated diagrammatically at D and E in Fig. 2. For lapping external spur gears, an internal gear-type lap is employed. This lap is designed to provide the maximum of enveloping contact, without interference, as shown at D, Fig. 2. The tooth spaces in the lap envelop the teeth of the gear. Lapping is done by reciprocation, and the rotary motion distributes the lapping compound.

For lapping an internal spur gear, the lap and the work simply change places, as shown at E, Fig. 2, the principle being identical. It is possible by this method of lapping to remove slight errors in tooth shape,

spacing, and eccentricity. The confining action provided by having the greatest possible number of teeth in contact makes control over tooth shape possible.

Control Over the Lapping Operation

While lapping is not intended as a stock removing process, it can within certain limits be employed for changing or modifying the position of the tooth bearing. Reference to A, Fig. 3, shows what is known as a full tooth bearing; that is, the bearing contact extends from the base circle to the top of the tooth. When a pinion is in operation with a larger gear, it is sometimes found desirable to have a full bearing on the pinion tooth and lower the bearing on the gear tooth, as shown at B. In other cases, where the gears are subjected to heavy loads causing tooth deflection, the bearing on both members may be lowered to obtain better operating conditions. These requirements can be taken care of in the finish cutting operation; or, where slight modification is necessary, it can be accomplished in the lapping operation.

When lapping external helical gears with three external helical gear-type laps, the work is rotated at speeds in the vicinity of 125 to 140 surface feet per minute, and reciprocated at from 200 to 250 strokes per minute. When it is desired to lower the bearing on the gear being lapped, the rotary speed is increased and the number of strokes decreased. This increases the relative rotary slippage between the teeth on the work and laps, and lowers the bearing.

On the other hand, when it is desired to raise the bearing, the rotary speed is reduced and the rate of reciprocation increased. This reduces the relative rotary slippage and tends to raise the bearing. In other words, when the lapping is accomplished by rotary slippage or sliding, the bearing is lowered; and when the lapping is done by reciprocation, the bearing is raised. When the only objective is to smooth the working profiles of the teeth without lowering or raising the bearing, the rotary surface speed of the gear should be 140 surface feet per minute, and approximately 200 strokes per minute.

When there is a condition of taper bearing, resulting from an enlargement of the gear at one end, as shown at C, Fig. 3, the stroke length of the work should be increased to over-run the lap, and so positioned with relation to the lap that more lapping is done at the large end of the tooth.

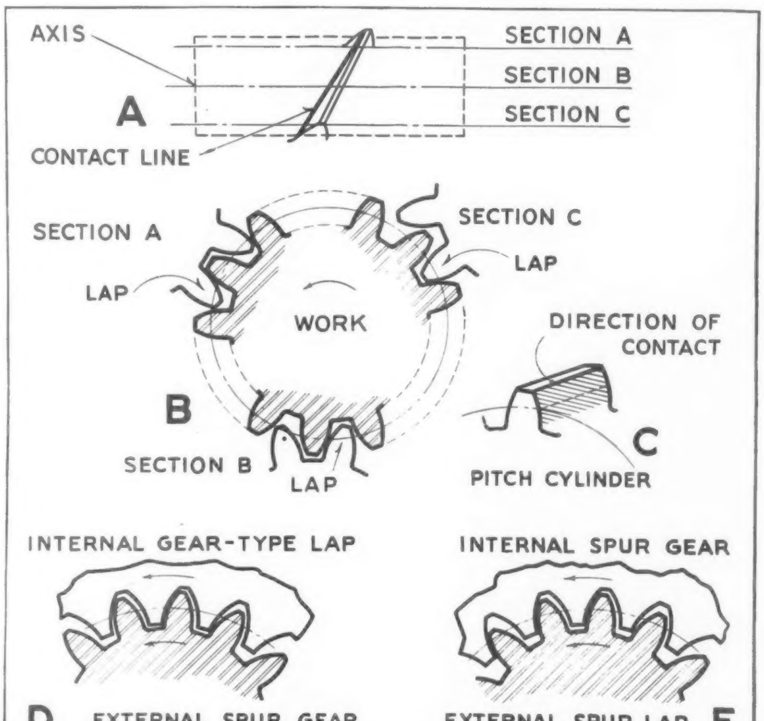


Fig. 2.—Diagram illustrating principle of Lapping External Helical Gears with Three Helical Gear Type Laps, also Internal Type Lap for Spur Gears.

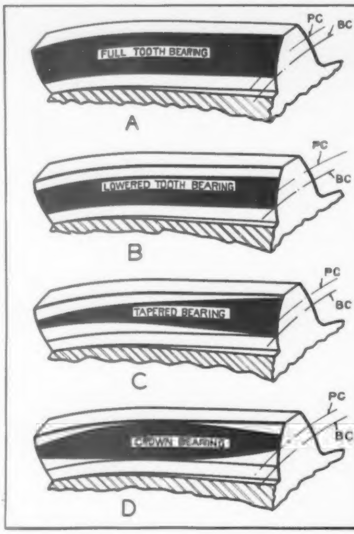


Fig. 3.—Diagram showing "full," "low," "tapered" and "crown" Tooth Bearings.

To slightly crown the bearing making it heavier in the center than at the ends, as shown at D, set the stroke length of the work so that the gear will come flush with the edges of the laps. To lengthen a crowned bearing over-run the gear on the laps.

To salvage gears which show a pronounced distortion of helix angle, the two upper lap spindles are adjusted out of line with the lower spindle so that the laps act on the end of the tooth that is distorted out of the required helical path.

Gears which have a wider bearing on one side of the tooth than the other can be corrected by lapping longer on one side of the teeth. This can be accomplished by setting the definite time relays. Such relays provide lapping time from 2 seconds to 32½ minutes in either direction. By changing the position of levers provided, the time of lapping is controlled automatically. These relays are independently adjustable, making it possible to set the machine to lap longer on the "drive" or "coast" sides of the teeth as required; or, to change the position of the tooth bearing, as previously explained.

Speeds for Lapping Spur Gears

The speeds recommended for lapping spur gears, using an internal spur gear-type lap, are from 85 to 95 surface feet per minute for the rotary speed, and 250 strokes for reciprocating speed. It is possible to change the location of the bearing by this type of lap. But, owing to the nature of the envelop-

(Continued on page 40)

SIZE MEASUREMENT OF GEARS

By

W. L. CHESLEY

Gear Engineer, Chrysler Corporation

It is the purpose of this article to present to those most closely connected with the manufacture of gears an easily understood method of calculating the sizes over pins or balls for spur or helical gears.

There have been several rules of one sort or another developed; some of them theoretically correct and some not. There are cases where the arrangement of formulas is such that the average user finds it extremely difficult to make use of them, or else they are too long and tedious to be correctly understood or applied.

To eliminate most of the existing troubles, the thought came to the writer of developing a complete set of consistent formulas for both spur and helical gears of either the external or internal character, with the result that they are being presented herewith with the hope that they will satisfactorily serve the purpose.

The chief advantage of measuring gears by the pin or ball method is the extreme accuracy which can be obtained and which is necessary in these days of improved methods of production.

The conventional methods of measuring, such as with gear tooth calipers, or master gears, are not good enough in a great many cases. The tooth calipers could not be adjusted to a fine enough reading or held in contact on the gear with sufficient accuracy to get consistent results. Nor is it practical to make master gears of a sufficient degree of accuracy without going to prohibitive cost, so that a much more uniform, as well as a more accurate, method seems to be mostly desired.

Mass production of gear trains such as used in the automobile as made today, or on any other precision machine, usually calls for a minimum amount of backlash. To get this condition consistently, naturally requires close limits in the manufacture of the article. The movement of steel in heat treated gears is quite frequently encountered, and inasmuch as this movement amounts to minute changes, it is essential that some sort of measurement be employed that will give a reasonable degree of accuracy.

By the selection of sizes by the ball method of measurement, it is possible to find out what is happening during the heat treatment, for the reason that this measurement can be taken at various points along the involute portion of the tooth by employing balls of different sizes and getting their corresponding measurements. It can therefore be readily seen that any movement in the growth of the material can be detected and exactly where this change takes place.

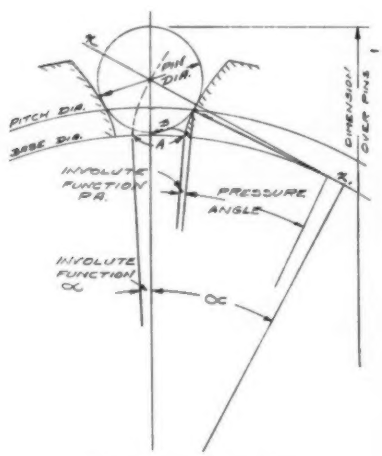


Fig. 1.—External Spur Gears.

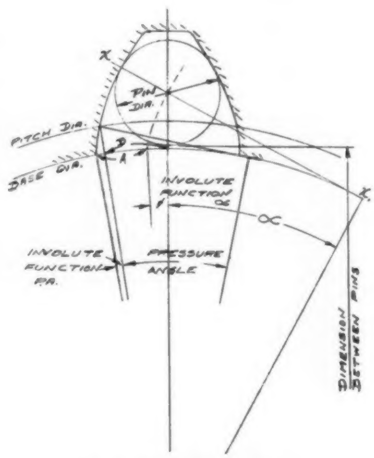


Fig. 2.—Internal Spur Gears.

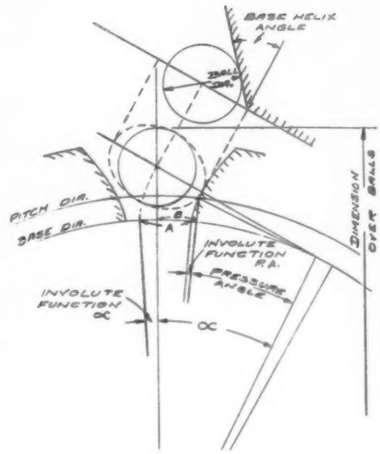


Fig. 3.—External Helical Gears.

If any attempt is made to obtain an accurate size of the helical type of gear, the use of ordinary tools for measuring quite frequently leads to disastrous results, so that an accurate method of sizing is essentially a God-send. The helical gear is in reality an involute thread with all the elements of the tooth parallel to the axis in the state of curvature, and this you can readily see presents a problem, as it is frequently impossible to locate tooth calipers at some fixed point and be assured that the results are always consistent.

With the use of a pair of balls and two anvils set at opposite sides of the gear and a given distance from its face, it's a simple matter to measure the size with ordinary micrometers within a limit of .00025.

The many measurements the writer has made employing this method have proven beyond a doubt their value, particularly in the elimination of spoiled work and all the worriment that goes along with any doubtful method.

If you will refer to figures No. 1 to No. 4 inclusive, you will obtain the graphical solution of the formulas which we recommend using

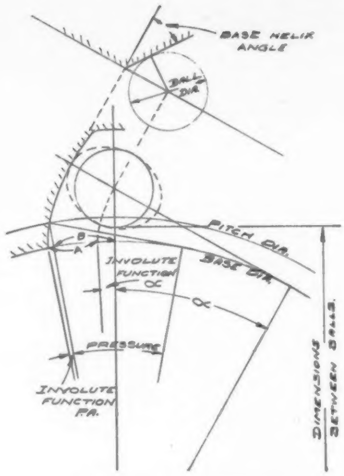


Fig. 4.—Internal Helical Gears.

for measuring gears by the method under discussion.

You will note that the contact always takes place at a point on the involute of the tooth and in the line of action indicated by a line XX which passes through the center of the pin or ball and lies tangent to the base diameter. This condition always holds true no matter where the point of contact on the tools takes place.

The process of developing the formulas has been to assume a base radius equal to one which brings all values in terms of radians. The main feature which we wished to solve in the developing of the formula was to find the value of angle alpha (a) which involved in this case the use of the table of involute functions that can be easily found by referring to Prof. Buckingham's recent book of tables for the solution of gear problems. This book is published by the Machinery Magazine. As angle alpha (a) has been established, it is an easy method to triangulate for the center distance between the pins or balls.

These formulas have all been developed along similar lines, so that outside of a few changes between one and another, they are essentially alike.

FOR SPUR GEARS

GIVEN:—

No. T = Number Teeth
D.P. = Diametral Pitch
P.D. = Pitch Diameter
B.D. = Base Diameter
P.A. = Pressure Angle
B.L. = Backlash within gear

$$\text{Pin Dia.} = \frac{1.68}{\text{D.P.}}$$

INV. FUNCTION (a) FOR EXTERNAL SPUR GEARS =

$$\frac{(\text{Pin Dia.}}{(\text{Base Dia.}} + \text{Inv. Function P.A.}) - \frac{(1.5708}{(\text{No. T.}} + \frac{\text{Mean B.L.})}{\text{Base Dia.})}$$

INV. FUNCTION (a) FOR INTERNAL SPUR GEARS =

$$\frac{(1.5708}{(\text{No. T.}} + \text{Inv. Function P.A.} + \frac{\text{Mean B.L.})}{\text{Base Dia.})} - \frac{(\text{Pin Dia.})}{(\text{Base Dia.})}$$

Dimension over pins (even teeth) = B.D. × Secant (a) ± Pin Dia.

Dimension over pins (odd teeth) =

$$\text{B.D.} \times \text{Secant (a) Cos.} \frac{90}{\text{No. T.}} \pm \text{Pin Dia.}$$

FOR HELICAL GEARS

GIVEN:—

No. T. = Number Teeth
D.P. = Diametral Pitch
N.P. = Normal Pitch
P.D. = Pitch Diameter
B.D. = Base Diameter
P.A. = Pressure Angle
B.L. = Backlash within gear
H.A. = Helix Angle
B.H.A. = Base Helix Angle

$$\text{Ball Dia.} = \frac{1.68}{\text{Normal Pitch}}$$

Tan. Base Helix Angle = Tan. Helix Angle × Cos. P.A.

INVOLUTE FUNCTION (a) FOR EXTERNAL HELICAL GEARS =

$$\frac{(\text{Ball Dia.} \times \text{Secant B.H.A.}}{(\quad \text{Base Dia.}} + \text{Inv. Function P.A.}) - \frac{(1.5708}{(\text{No. T.}} + \frac{\text{Mean B.L.})}{\text{Base Dia.})}$$

INVOLUTE FUNCTION (a) FOR INTERNAL HELICAL GEARS =

$$\frac{(1.5708}{(\text{No. T.}} + \text{Inv. Function P.A.} + \frac{\text{Mean B.L.})}{\text{Base Dia.})} - \frac{(\text{Ball Dia.} \times \text{Secant B.H.A.})}{(\quad \text{Base Dia.} \quad)}$$

Dimension over balls (even teeth) = B.D. × Secant (a) + Ball Dia.

Dimension over balls (odd teeth) =

$$\text{B.D.} \times \text{Secant (a)} \times \text{Cos.} \frac{90}{\text{No. T.}} + \text{Ball Dia.}$$

EXAMPLE:—

Find dimension over pins in a spur gear of the following specifications:

No. T. = 30
Dia. P. = 10
P. Dia. = 30 ÷ 10 = 3.000
Base Dia. = 3.000 × .93969 = 2.8191
P.A. = 20°
Backlash = .003
Pin Dia. = 1.68 ÷ 10 = .168

$\frac{\text{Pin Dia.}}{\text{Base Dia.}}$ = .168 ÷ 2.8191 = .059595

Inv. Function P.A. (use table functions) = $\frac{.014904}{.074499}$

$\frac{1.5708}{\text{No. T.}}$ = .05236

Mean B.L. = $\frac{.003}{.05536}$

Inv. Function (a) = $\frac{.05536}{.019139}$

Angle (a) (use table functions) = 21°— 40′— 18″

Secant 21°—- 41′— 18″ = 1.07603

Dimension over pins = 2.8181 × 1.07603 + .168 = 3.2014

EXAMPLE:—

Find dimension over balls in helical gear of the following specifications:

No. T. = 30
Dia. P. = 10
T. Dia. = 30 ÷ 10 = 3.000
Hel. Angle = 30°
Base Dia. = 3.000 × .93969 = 2.8191
P.A. = 20°
Backlash = .003
Normal Pitch = 11.547
Ball Dia. = 1.68 ÷ 11.547 = .1454
Tan. B.H.A. = .93969 × .57735 = .54253
B.H.A. = 28°— 29′

$\frac{\text{Ball Dia.} \times \text{Secant } 28°—29′}{\text{Base Dia.}} = \frac{.1454 \times 1.1377}{2.8191}$ = .058671

Inv. Function P.A. (use table functions) = $\frac{.014904}{.073575}$

$\frac{1.5708}{\text{No. T.}}$ = .05236

Mean B.L. = $\frac{.003}{.05536}$

Inv. Function (a) = $\frac{.05536}{.018215}$

Angle (a) (use table functions) = 21°— 20′

Secant 21°— 20′ = 1.0736

Dimension over balls = 2.8191 × 1.0736 + .1454 = 3.1719

LOCATING GEAR TROUBLES

By
J. C. Drader
Chief Engineer, Michigan Tool Company

Good gears are not a matter of accident. They are the result of selecting the right kinds of steels, methods, insuring correct heat treating, and constantly watching and adjusting to variations in conditions encountered. Of course, in high production it is not practical to check up on every gear blank minutely after each step in its manufacture. In large scale production it can be assumed that if one gear blank of a certain lot goes through all the operations satisfactorily, that others of the same lot manufactured under the same conditions and from the same material should be similarly satisfactory.

Unfortunately the definition "same material" is a very flexible one. Most gears have to be heat-treated after machining, and are thus vitally affected by any difference in grain structure, physical or chemical characteristics, etc. that may cause variations in dimensional specifications due to heat-treating. Steel manufacturers today are able to produce gear steels which in any given batch or "heat" will be fairly consistent, but steels of different heats may vary considerably in spite of the fact that the steel may be produced to the same physical and chemical specifications.

Control of gear manufacture should begin with the finished product and work backward. There is really only one final check on whether a gear is good or bad, whether it has been made right or not, and that is on the basis of how it will operate in actual service. Since checking of gears in actual operation is obviously impossible in production it seems evident that the best thing to do is to check every gear, or at least one out of every so many gears on a gear speeder, so designed as to duplicate as nearly as possible actual operating conditions. A machine meeting these specifications is shown in Fig. 1. On this type of machine, production gears are run in mesh with master gears or in pairs of mating gears, mounted at the proper center distances. The speeder is provided with separate brakes on the two gear shafts so that the gears can be put under various loads while running to duplicate operating conditions. They can be run both forward and backward so that a check can be had on characteristics under not only driving and coasting but also reverse load conditions. Such a check gives a clear and complete picture of whether a gear is satisfactory or not. Wherever tolerances in gears are important there should be 100% "speeder" inspection of gears.

Fig. 1.

The gear speeder, of course, only tells the final story as to whether a gear is good or bad. It does not definitely tell why a bad gear is not good or what has made it unsatisfactory. When gears are found coming through which are not satisfactory for service, an analysis should be made to determine the reasons therefor. For this purpose accurate gear analysis equipment is essential and should form an integral part of any gear manufacturing lineup. The various factors in gears which require checking are: pitch diameter, eccentricity, tooth form, tooth spacing and helix angle or spiral lead. When it has been determined which of these measurements are different in the bad gears from the good ones, it becomes possible to check back quickly through the production process to locate the cause of the variation or error.

Incorrect pitch diameter, of course, affects mainly the back-lash in assembling mating gears. On the whole, more back-lash is preferable to less, although quite a little tolerance is usually permissible in this specification. If the pitch diameter is excessively high, back-lash may be too small, causing interference trouble in running, similar to the conditions experienced when gears are eccentric. Causes of incorrect pitch diameter are usually found either in machine settings or in heat treatment, usually the latter. The amount of distortion in heat treating depends largely on the steel used and allowance should be made for this in the setting of the finishing machines. A shaving machine of the type shown in Fig. 2 permits rapid adjustment to growth or shrinkage in heat treatment. The presence of errors in pitch diameter are quickly located by placing the gears over pins or balls.

Photo Courtesy Chevrolet Motor Company

Fig. 2.

Gears which are eccentric with respect to the shaft on which they are mounted, produce a variable back-lash around the circumference of the gear as it rotates. This variation becomes quite important where relatively small total back-lash is specified. On the large side of an eccentric gear for instance, the absence of clearness may cause lubricating oil to be squeezed out from between the teeth causing noise and undue wear. Where eccentricity is excessive a decrease in back-lash may easily spring the shafts on which mating gears are mounted. Eccentricity is sometimes discernible directly on the gear speeder in the form of beat-notes, with one beat for every revolution. The best check to determine whether an unsatisfactory gear is suffering

from eccentricity, however, is by rolling it in mesh with a master gear on the gear speeder. The check can be made with an indicator, but the use of a master gear is preferable, since with it all tooth bearing surfaces can be brought into contact with the master gear in turn as they are rotated in mesh, and a more accurate and complete observation can be made. With gears of low pressure angles eccentricity is somewhat less important than with gears of high pressure angles. Eccentricity in gears is generally traceable to the machining setup. Included in the factors frequently contributing are untrue arbors, defective centers, and particularly to the clamping of gears on arbors if the side faces are not true, throwing the gear blank out of line. Light finishing machines, lacking in rigidity, sometimes will leave gears eccentric if in the roughing operation an unequal amount of stock has been left on different sides of the gear. Under such conditions a light machine will frequently deflect sufficiently so that it will not correct for unequal roughing. A major cause of eccentricity in gears is in the eccentricity of the tools themselves.

Tooth form and tooth spacing are specifications which should be checked together since they closely affect one another as to final result and since errors in both will produce more or less the same characteristics. Unequal tooth spacing means that teeth are moving in and out of engagement in such a manner as to produce uneven rotation of the gears. Inaccurate spacing results in taking up or releasing the load before or after the proper time. The result is noisy gears or even a rattle. Impact of one tooth on another, due to errors in spacing, frequently results in undue wear.

The same effects are brought about by incorrect tooth form. The latter may be said to include lack of smoothness of the tooth surfaces. This affects the sound of running gears and in addition to this the highpoints of a rough tooth surface have a tendency to break through the oil film thus causing wear and metal-to-metal contact noise.

Where only a few teeth are in theoretical contact, with helical gears, errors in tooth spacing become more noticeable from a noise standpoint. With a large number of teeth in contact due to overlapping of helical teeth, tooth spacing errors on the whole produce less percentage of error but tooth spacing and form must be more carefully watched and held to closer tolerances if full advantage of the entire amount of overlap is to be conserved.

Causes of incorrect tooth form include undue wear of the cutters and lack of uniformity of rotation between the work and the cutter. Smooth rotation of the cutter is essential to the production of accurate tooth forms. Inaccuracies in the finishing tools may also contribute to this effect. Smoothness of cut is important. Some steels have a tendency to tear instead of cutting, frequently resulting in rough surfaces. Cutting coolant has an important bearing on the smoothness and accuracy with which gear teeth are finished.

Causes of incorrect tooth spacing include both lack of uniformity of rotation between the cutter and the gear, particularly in hobbing and shaping and improper spacing of cutter teeth.

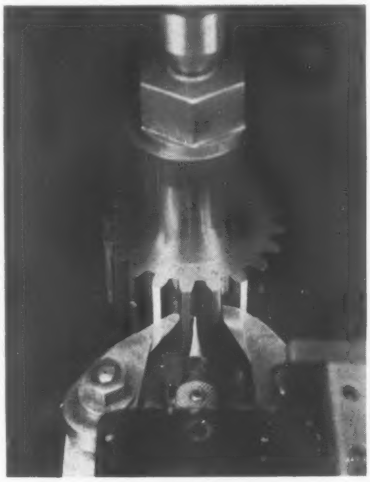


Fig. 3.—Detail of the Michigan Involute and Spacing Checker showing method of taking both measurements.

Tooth form and tooth spacing may be best checked on an involute and spacing checker of the general type illustrated in Fig. 3. These two factors should be checked together. The involute checker shown gives a zero indicator reading at all points when the tooth form is accurate. To check for tooth spacing on this machine there are provided a solid finger contacting one side of one tooth and an indicator for the same side of an adjoining tooth. A spring maintains uniform tension of the finger against the gear tooth. Thus, the indicator will show any deviation in tooth spacing. With this arrangement it is possible to check on both the line of action and on the pitch line. Checking spacing along the line of action alone does not indicate whether the error is in the involute or in the tooth spacing. This information is necessary to permit locating and correction of the factors which produced the poor gear.

Involute form of various types of gears can be checked on the "Michigan" machine shown, by merely changing the adjustment. Simple adjustments are preferable to changing base or pitch diameter, master discs or rolls. The latter sometimes produce false readings when master rolls or discs are accidentally mounted eccentrically when changing the machine over for another type of gear.

Trueness of mounting of the gear particularly as to side faces on a finish cutting machine, is one factor that contributes to accuracy or error in the helix angle or spiral lead of the finished product. Accurate finish turning of the blank is vital if the helix angle or spiral lead is to be accurate. Most important sometimes in contributing to errors in this specification is the gear blank itself. The blank must be of good homogeneous material so that it will not distort in heat treatment. Errors are also introduced by a mere transfer of errors in the mechanism of the machines which control the amount of lead cut into the gear.

If helix angles do not correspond to each other in mating gears, the teeth will be bearing on only a small portion of their total length. This results in an over-load condition on the actual contact area, giving excessive wear and causing tooth deflection. Errors in helix angles or spiral leads destroy or minimize the one advantage of helical over spur gears: more teeth in contact.

In analyzing a bad gear for the possibility of errors in this direction it is preferable to check the spiral lead rather than the helix angle. The reason for this is that the lead is constant no matter at what depth or portion of the tooth the measurement is taken. This is not true of the helix angle and it is therefore entirely possible that an apparent error in helix angle may be only an error in the depth at which the measurement was taken. Similarly an apparently correct helix angle reading may give an erroneous picture since it may not have been measured at the correct tool depth.

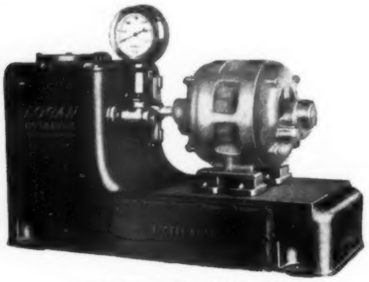
Thus, the checking of gears may become, as it should be, a vital factor in the production of consistent and accurate gears. When applied in a sensible manner—as a means of quickly identifying errors and locating their causes — the use of

(Continued on page 20)

NEW EQUIPMENT

Logansport Machine Incorporated, of Logansport, Indiana is now offering a new electric hydraulic power device known as Model 6035. It is designed for use where the operating cycles are of such frequent occurrence that there is no opportunity to build up reserve pressure.

The model is entirely self-enclosed, compact, and consists only of an oil storage tank in which is mounted a pump, relief valve, and pressure gauge. The top is removable for inspections and seals the equipment from all outside dirt.



Logansport Power Device

The motor, which runs continuously, is connected by a flexible coupling to a geared pump which delivers oil under pressure through the relief valve. When the pressure for which the relief valve is adjusted is reached, the relief valve automatically opens, allowing the oil in excess of the actual requirements to be returned to the storage tank.

Standard models are manufactured in 4 sizes with pump capacities ranging from 2 to 36 gallons per minute and with pressures ranging from 100 to 1000 pounds, and are easily attached to machines originally intended for manual operation.

This new machine, together with many other new models of hydraulic operated devices are described in a new bulletin No. AH-32 which will be gladly sent upon request. Mention "The Tool Engineer" when writing for your copy.

▼ ▼ ▼

R. G. Haskins Company, 4642 West Fulton Street, Chicago, Illinois has recently completed the development of a new feature known as "Haskins Air Control." The Haskins tapping machines are operated by means of an electric motor, the tapping operation being controlled by the operator through a foot pedal. The pressure on the pedal is transmitted through a safety pull spindle to the tap head. Unusual sensitivity in operation is claimed by this arrangement. The new Haskins air control has been developed, it is claimed, to still further increase the sensitivity and accuracy of the Haskins tappers and to decrease operator fatigue. A unit known as the air cylinder operates the foot pedal by means of an air operated plunger. This unit is under control of a foot operated valve which is connected to a source of compressed air and which regulates the amount of pressure delivered to the air cylinder. This new device, it is claimed, not only controls the speed of feeding and reversing the tap, but also maintains uniform pressure throughout the length of the stroke.

The principal reason for utilizing compressed air is to do away with the necessity of the operator having to gauge the pressure which is applied to the tap. The variable and somewhat uncertain human element is, thereby, replaced, it is said, by a pneumatic control that can be accurately regulated to meet exactly the requirements for each specific tapping job. It is claimed that this air control results in greater accuracy, longer tap life, less tap breakage, and a reduction of tapping costs because of greater net production.

▼ ▼ ▼

Delta Manufacturing Company, 619 E. Vienna Avenue, Milwaukee, Wisconsin, announces a new line of 17" drill presses. This new line is designed to serve the needs of the general machine shop, tool room, and production shop, and will be, it is claimed, a radical step forward in the production of high grade machine tools at comparatively low cost, giving built-in features an extra large spindle pulley providing five spindle speeds from 385 to 2240 r.p.m. Self-sealed New Departure Ball Bearings are included in this line. A feature of this machine is that the heads can be used as units to build up special drilling fixtures. Their low cost, it is claimed, makes them more economical than anything that can be built up in tool room or shop, and it is possible to use a number of heads together by linking the foot feeds to a common lever. Full details may be had by writing the Delta Manufacturing Company direct—or "The Tool Engineer."

▼ ▼ ▼

Ingersoll Ray Blade Core Drills and Reamers. The Ingersoll Ray Blade is now applied to boring tools either in core drills or reamers, made with solid shank or of the

Delta Drill Press

shell type. The Ingersoll Ray Blade is a double tapered blade locked in the cutter housing with a compensating serrated wedge. The cutter blade is tapered along its length so that, it is claimed, it will not push down or back from the thrust of the cut. It is also dove-tail tapered across its width to prevent it from pulling out of its locating slot. As the cutter blade is moved outward for regrinding for wear, the shape of the wedge permits its movement, either further along or down its serrated slot. The wedge thus compensates, it is claimed, for the thinning movement of the locked double tapered Ingersoll Ray Blade.

These Ingersoll Ray Blade boring heads are furnished with blades of Super High Speed Stellite or tipped with Cemented Carbide, fitted into housings of forged and heat treated alloy steel. Further information available from the Ingersoll Milling Machine Company, Rockford, Illinois.

▼ ▼ ▼

Hannifin Manufacturing Company, 621 S. Kolmar Avenue, Chicago, Illinois announces a new type of hydraulic straightening press available in capacities of 20, 35, and 75 tons. These new hydraulic straightening presses have been especially designed for straightening operations on cam shafts, axle shafts and for various types of work requiring accurate straightening.

(Continued on page 20)

A. S. T. E. CHAPTER NEWS

CLEVELAND

One year old! The Cleveland chapter, and my oh! my how the child has grown. If the interest continues at its present rate, 1937 should be a very successful one. We wish to thank the many Tool Engineers and industries that have helped us in our endeavor to make the Society a pleasant, instructive and profitable one for the Tool Engineers of Cleveland, and The General Electric Company, who have so kindly given us the use of their dining room where we hold our meetings on the third Tuesday of every month. Again we say, Many Thanks.

The December 15th meeting was one that will long be remembered by the one hundred and fifty guests and members who attended. In addition to being our first anniversary it also was a Christmas party. The ladies were invited. There was an excellent dinner, the caps, horns, noise makers, table prizes, Bingo prizes and door prizes, and what prizes!

The speaker of the evening was Mr. John W. Love, noted writer on industry and business. He gave us a very clear picture on industry as he saw it in the Soviet Union last summer.

Excerpts from Chapter Chairman Rudolph Fintz' opening remarks follow:

"On behalf of the A.S.T.E. it is my happy privilege and pleasure to extend to the members and guests, and especially the ladies, a most hearty welcome. You are privileged to attend our dinners at the regular monthly meetings and, after the dinner, be a guest of the General Electric Institute.

To the General Electric Company I wish to extend the Chapter's sincere appreciation and thanks for the privilege of meeting here and for your splendid cooperation in making this meeting possible.

We are here tonight to celebrate a twofold event—our first anniversary coupled with a little Christmas spirit.

In reference to our anniversary, there is this much to say; we can look back on our first year's program with a great deal of satisfaction and gratification. Our membership has been tripled in the past year and the National Organization is growing by leaps and bounds. Four new chapters have been recently created, namely, Chicago, Milwaukee, Hartford, and Bridgeport.

Monthly we have enjoyed prominent speakers, each adding to our knowledge of production processes."

DETROIT

The Detroit meeting, held at the Hotel Fort Shelby on the evening of December 10th, was presided over by Mr. A. E. Rylander, due to the absence of Mr. Winter, Chapter Chairman. Following a dinner attended by some 150 members and guests, and entertainment by the popular Plymouth Quartette, the technical session opened at 8 o'clock.

Mr. W. B. McClellan spoke on the Fall Festival and outlined the January meeting at which Mr. Cameron of the Ford Motor Company will speak. Mr. Rylander then described the new binders for the A.S.T.E. Standard Sheets. A notice regarding these binders will be found on another page in this issue.

Mr. Ford Lamb, President of the Society, next gave a brief resume of A.S.T.E. activities and growth. He mentioned specifically the mooted New York State Law regarding the educational requirements of engineers, however, it is quite definitely settled that the establishment of A.S.T.E. Chapters in New York State does not conflict with that law. Hence, we may expect action.

Called upon to introduce the speaker of the evening, Mr. Homer Bayliss, expressed just regrets for the absence of Mr. K. T. Keller, President of Chrysler Motors, who had been prevented from coming due to last minute problems at one of the plants. He then introduced Professor John J. Caton, Director of Chrysler Institute of Engineering, the speaker of the evening, who spoke on the subject "Behind the Scenes in Engineering."

Detroit Chapter A.S.T.E. expresses its appreciation to the Detroit Area Associated Machine Tool Distributors for its gracious gift of the expenses entailed in bringing Professor John Younger, of Ohio State University, to the November meeting.

Detroit A.S.T.E.ers recall that Professor Younger came specially to Detroit from Columbus, Ohio, to deliver his talk on Jigs and Fixtures, which proved to be so highly practical and interesting.

MILWAUKEE

The December meeting of the Milwaukee Chapter was a marked success. There sems to be an enthusiastic reception to papers delivered by our local talent.

Mr. E. Rutzin, of Cutler-Hammer Corporation, presented a paper on the co-ordination of tool procedure, which was interesting because of the fact that most engineers consider tool orders and records clerical work, and he pointed out that this detail work is very important. He stated that time and money can be saved if the tool orders and records are supervised by a competent tool engineer.

In a black board discussion Mr. George Smart, Chairman, delineated upon ways to clear a punch of slugs. Those who offered suggestions were Messrs. Art Johnson, Harold Heywood and Joseph Miotke.

The principal speaker of the evening was Mr. A. Altenhoefer, of the Carnegie-Illinois Steel Corporation. His talk, together with six reels of motion pictures, on the manufacture of tin plate and sheet steel was very enlightening. Many of our Tool Engineers were amazed at the number of operations required to manufacture one piece of sheet steel.

Mr. Harold L. Heywood, member A.S.T.E., has been advanced to Chief Inspector of Kearney Trecker Co., Milwaukee, Wis.

▼ ▼ ▼

We suggest that the genial Chairman of the Milwaukee Chapter, Mr. George Smart, write the jokes he tells on tracing paper so that the members can see through them.

▼ ▼ ▼

The Allis-Chalmers After Dinner Octette will be available for engagements on the concert stage as soon as they find seven good men to harmonize with their first tenor, Al Tank.

▼ ▼ ▼

We wonder what our speaker Mr. Altenhoefer of Carnegie thought after he had explained the manufacture of tin cans, to see the boys enjoying their amber fluid from brown bottles.

RACINE

The regular monthly dinner meeting of the Racine Chapter, American Society of Tool Engineers, was held

Monday night December 14th, at 6:30 P. M. in the main dining room at Hotel Racine. It was well attended by the local engineers and their guests as well as by Tool Engineers from the adjacent cities of Kenosha and Milwaukee.

The main speaker of the evening was Mr. Paul S. Jackson, Assistant General Manager of the Rockford Machine Tool Company of Rockford, Illinois, who spoke on the subject—"Hydraulics as Applied to Machine Tools and Fixtures."

The machines he covered that were hydraulically equipped, were Shapers, Openside Planers and Vertical Slotters.

During his talk, he pointed out and showed by lantern slides, how the ram was fed hydraulically on the cutting stroke and reverse, how the work table on the shaper and the rail on the planer was moved up and down by hydraulic power. He also told and illustrated how the length of the stroke was controlled by a simple valve. He also illustrated the performance of the ram on a chart to show the curve and in so doing brought out the point that a hydraulically operated shaper was considerably more efficient than one mechanically operated, because the curve showed that this gave it a smoother cutting stroke, keener on the reverse and faster on the return. He also had one of their latest hydraulic shapers on display, which was demonstrated to the engineers by one of their operators present.

A discussion was held after the talk during which Mr. Jackson answered a number of questions asked by the engineers.

New Equipment

(Continued from page 18)

Simplified handling of straightening operations and increased production are features claimed resulting from the exclusive design of the control mechanism. On the new type Hannifin 20 ton hydraulic press, a single lever controls the entire operation of the ram, with an extremely sensitive proportional action. When the control lever is moved in either direction, the ram will move a proportional distance and then stop by automatically bringing the operating valve to neutral. Thus the operator, merely by moving the one operating lever, obtains a ram movement at 20 tons pressure through the exact distance required for the straightening of any piece. Very slight and accurate ram movements, either up or down, may be obtained. The arc of movement of the control lever is several times the ram stroke, providing for very sensitive handling without, it is claimed, requiring the development of special skill on the part of the operator. For further details and specifications, write the Hannifin Manufacturing Company direct mentioning "The Tool Engineer."

NEW Trade Literature Available

Sundstrand Bulletin No. 2 "Electromil." This is a twelve page bulletin profusely illustrated with photographs, close-ups, detail views, and many diagrams covering the important new features and specifications of this "Electrically Controlled Rigidmil for High Speed Economical Operation on Small Work-pieces." When writing the Sundstrand Machine Tool Company, Rockford, Illinois, please mention "The Tool Engineer."

▼ ▼ ▼

Landis Tool Company, Waynesboro, Pennsylvania, has just issued a completely new catalogue describing the Landis 16" Type D Hydraulic Crank Pin Grinders. It is designated as No. N-36 and is freely illustrated with many new views and closeups of this machine. This catalogue is available to anyone who may wish a copy.

▼ ▼ ▼

"Haskins Method of Setting Screws and Nuts—Bulletin No. 54-S" —is the title of a handsome new twelve page bulletin issued by the R. G. Haskins Company, 4642 West Fulton Street, Chicago, Illinois. In this bulletin a detailed, concise description of the Haskins method of applying screws and nuts is given. An explanation of the adaptability of this equipment to assembly operations as well as for various types of production work and some of the unusual features of this equipment is also given. The bulletin contains many illustrations showing sectional views of important parts, photographs of the equipment being used and various manufacturing operations and types of mounting the Haskins equipment for greater facility, depending upon the type of assemblying being done. Available to all manufacturing executives requesting on their firms' letterhead. Mention "The Tool Engineer" when writing for copies.

Colonial Broach Company, Detroit, Michigan, has issued a series of four page bulletins, all illustrated, with specifications, etc., covering the following types of equipment: Colonial Power Presses, Colonial Dual Ram, Colonial "Utility" Presses, Colonial Heavy Duty "Pull-up," and Colonial High Speed "Pull-up" Broaching Machines. Copies of any or all of these bulletins are available on request.

Locating Gear Troubles

(Continued from page 17)

such equipment not only will result in the maintaining of a higher standard of quality, but will also aid toward the ends of increased production and minimizing of troubles. On the whole gear checking equipment is trouble-shooting equipment, and when regarded from this standpoint it has a vital place in every plant desirous of producing better and more consistent gears at a lower cost.

For A.S.T.E. Standard Sheets

A black, seal grain, three-ring binder lined with black moire, with A.S.T.E. Emblem and STANDARDS in gold on front cover, can be purchased for $1.25 plus mailing cost. Kindly mail orders to 5928 Second Boulevard, Detroit, Michigan.

▼ ▼ ▼

Employment Applications

Applications for employment will remain on file with the American Society of Tool Engineers for 30 days only, unless renewed. Please notify Secretary's Office: 5928 Second Boulevard, Detroit, or telephone, MAdison 0649, if you accept a position.

Notice

In order that no misunderstandings may arise, it is again emphasized that the A.S.T.E. does not sponsor the subject matter of articles in "The Tool Engineer" or of speakers at its meetings, or of literature distributed at sessions unless signed by authorized committees of the Society. Members and guests are asked to consider all such expressions as personal opinions of the writer or speaker and not as the considered opinion of the A.S.T.E.

JANUARY CHAPTER MEETINGS

Chapter Meeting Announcements must be received on or before the 20th of preceding month. Omissions are the result of not receiving this information by this date—in time for publication.

CHICAGO

January 11, 1937
Dinner: 6:30 P. M.—$1.00 per plate
Technical session at 8:00 P. M.

Machinery Club, 571 W. Washington Blvd.

Speakers: BYRON C. BRONSON, Master Mechanic, Elgin National Watch Company.
HERMAN NISS, Elgin National Watch Company.

Subject: "Production of Fine Watches."

This topic will be presented in conjunction with an interesting moving picture showing various manufacturing operations throughout the Elgin National Watch Company plant in Elgin.

A large turn out is expected for this unusually interesting topic, and all are urged to make their reservations with Mr. Willard Wilson, 1026 S. Homan Avenue, as soon as possible.

CLEVELAND

January 19, 1937
Dinner: 6:30 P. M.—$1.00 per plate
Technical session at 8:00 P. M.

The Colonial Hotel—523 Prospect Avenue

Speaker: MR. GUY HUBBARD, Associate Editor, Machine Design, Penton Publishing Co., Cleveland, Ohio.

Subject: "What's Doing in Machine Tools?"

Mr. Hubbard has had twenty years of practical machine shop design and general engineering experience. He was engaged in consulting work, primarily with Cone Automatic Machine Co., Windsor, Vermont, and five years editorial work with the American Society of Mechanical Engineers and The Penton Publishing Co.

He is extremely well qualified to interpret technical development in the machinery building field. His earlier training included specialization in machine design at New Hampshire State College, as well as a special apprenticeship in the toolroom and ten years in the engineering department of Windsor Machine Co. and their successors National Acme Co.; also invention development on bread-wrapping machines.

During the war he served with the Ordnance Deparment in United States nitrate plant, Muscle Shoals, also National Recovery Administration in Washington on the preparation of machine tools.

Make reservations immediately with Mr. G. J. Hawkey, Penton Building, Telephone Main 0112, to insure a dinner place.

DETROIT

January 14, 1937
Hotel Fort Shelby—Spanish Grill Room—Dinner: 6:30 P. M.
Entertainment—Including the "Dixie 8"—Meeting: 8:00 P. M.

Speaker: Mr. W. J. CAMERON, Ford Motor Company

Mr. Cameron is so well known he needs no introduction. His subject, unannounced, will deal with some present day topic of vital interest and importance to the tool engineer.

This meeting, it is anticipated, will be so well attended that our usual facilities will be taxed to the utmost. Members and guests who plan to attend the dinner should make reservations immediately through Detroit A.S.T.E. offices.

MILWAUKEE

January 14, 1937
Boys' Trade and Technical High School, 319 W. Virginia St.
Dinner: 6:00 P. M.—School Cafeteria
Music by Allis-Chalmers Orchestra

8:00 P. M. Tour of Building, including Machine Shops and Tool Room

9:30 P. M. Addresses by Speakers.

Mr. Thomas G. Brown, Principal of the Boys' Trade and Technical High School.
"The Place of the Technical High School in the Community."

Mr. F. W. Ziegenhagen, Vice-Principal of the Boys' Trade and Technical High School, and Principal of Mechanics Institute.
"The Mechanics Institute as a Factor in Trade Training and Extension."

Mr. R. A. Radtke, Supervisor of Industrial Arts, Milwaukee Public Schools.
"Industrial Arts, an Integral Part of General Education and Trade Training."

An unusually large attendance is anticipated for this meeting—make your reservations early—tickets 75c upon admission to the meeting.

Readers of "The Tool Engineer" and friends of the American Society of Tool Engineers, whether members or not, are cordially invited to any of the above meetings.

HANDY ANDY'S ..WORKSHOP..

Writing this before the Holidays. I am wishing all the boys a Merry Christmas and a Happy New Year. I know that you are going to have a busy and prosperous year. Remember now—I made this wish before Christmas.

▼ ▼ ▼

I want to tell you boys North East West South that the men you elected to the Directorate are real guys and very much on the job. They took hold like veterans at their first meeting, and offered so many good suggestions that they not only proved themselves an asset to the Society but a credit to themselves and the men who elected them. More power to you, Messrs. Todd, Goddard, Gordon and Smart. We'll work together to make the A.S.T.E. the best engineering society in the register.

▼ ▼ ▼

Did you know that Prexy Lamb put the Tool Engineers in the columns of American Machinist? Well, he did, and a right good job he made of it. Better read it, in the December 2nd issue. Atta boy, Ford!

▼ ▼ ▼

I see the Cleveland Chapter was highly honored by the presence of Miss Joy Simp-son at the Christmas party. Miss Simp-son gave us some of the inside Dope on her cousin in Europe.

"She" wore one of the latest Parisian creations. Her figure and complexion were the envy of many of the ladies.

Yes, Jack Hawkey, (Cleveland Chapter's most efficient secretary) you were a scream. You certainly believe in doing a job right. Too bad there aren't more like you.

▼ ▼ ▼

Paulus Zerkle, Chairman, Entertainment Committee, certainly made a good job of that Christmas party. We bet he stayed up nights thinking about it.

In our November issue we failed to mention that Mr. W. N. Delenk is another Cleveland A.S.T.E.er who teaches tool designing at Fenn College. Sorry W.N.

▼ ▼ ▼

The Chairman of the Publicity Committee of the Cleveland Chapter, Mr. P. F. Rossbach, suggests that anyone having news of the Cleveland Area that would be of interest, should get it to him by the 15th of the month. Mr. Rossbach can be reached at Eaton Mfg. Co., 739 E. 140th Street, Cleveland, Ohio.

▼ ▼ ▼

Prof. John J. Caton, of the Chrysler Institute of Engineering, has plenty on the ball. Nothing namby-pamby about him, but a two fisted fighter who bucked the game of life and made a goal. (You should have heard his story about the piccolo player.) Anyway, he invited us to break bread at the Chrysler Institute come the early part of '37. Want to come?

▼ ▼ ▼

I have my eye on a young fellow named Eaton, who works at Burroughs. Unless I miss my guess, that chap is going places in the Society. How'd you like to go to work right now, Eaton? I have a good job for you, about once a month—and it's only across the street. Interested?

▼ ▼ ▼

Had a real good time at the Fall Festival (the A.S.T.E. Stag, you know) and cemented a few friendships. Also, I learned (?) a new game, played with some kind o' dominoes. Quite fascinating. Funny thing about that—uh, aesthetic dancer, though. She was supposed to wind up in a blaze of glory (is that right?) but at the grand finale she just petered out in fzzzzzzz! Too much smoke to shed light on the subject. Oh well!

▼ ▼ ▼

It seems that the student delegated to sell chances on the drawing kit at a recent meeting forgot to bring the tickets along. Like Obadiah Smith. Sent to interview a client in a distant city, he quite forgot the name of the man he was to see, and wired back for information. His boss replied. "Client's name is Floyd Pettys your name Smith."

▼ ▼ ▼

This time, I nominate Bill Hart (of Michigan Tool, not the silver screen) to my A.S.T.E. Hall of Fame. It seems that whenever we are in a tight spot for an article on some special subject Bill usually comes across with something interesting. (And Bill, give my thanks to your boss when you see him.) The best part of it is that the Hartzian stuff comes all ready for publication, which saves a lot of grief to harazzed editors. Thanks ol' timer.

▼ ▼ ▼

Have you heard this one? During a Church concert, someone in the audience impugned the piccolo player's ancestry. Then, from the outraged priest: "Who called the piccolo player that vile name?" No answer, then, after the priest had reiterated his challenge, an Irishman at the rear spoke up. "Y'r Riverance, I don't know who called the piccolo player a !*-?&*@*!, but what I want to know is who called that sonofa@&!*!?! a piccolo player?"

▼ ▼ ▼

I called on Otto Winter recently, down Toledo way. He is doing right well, as would be expected of a progressive young engineer from dynamic Detroit. He sends his best regards to the boys in the Big Town.

▼ ▼ ▼

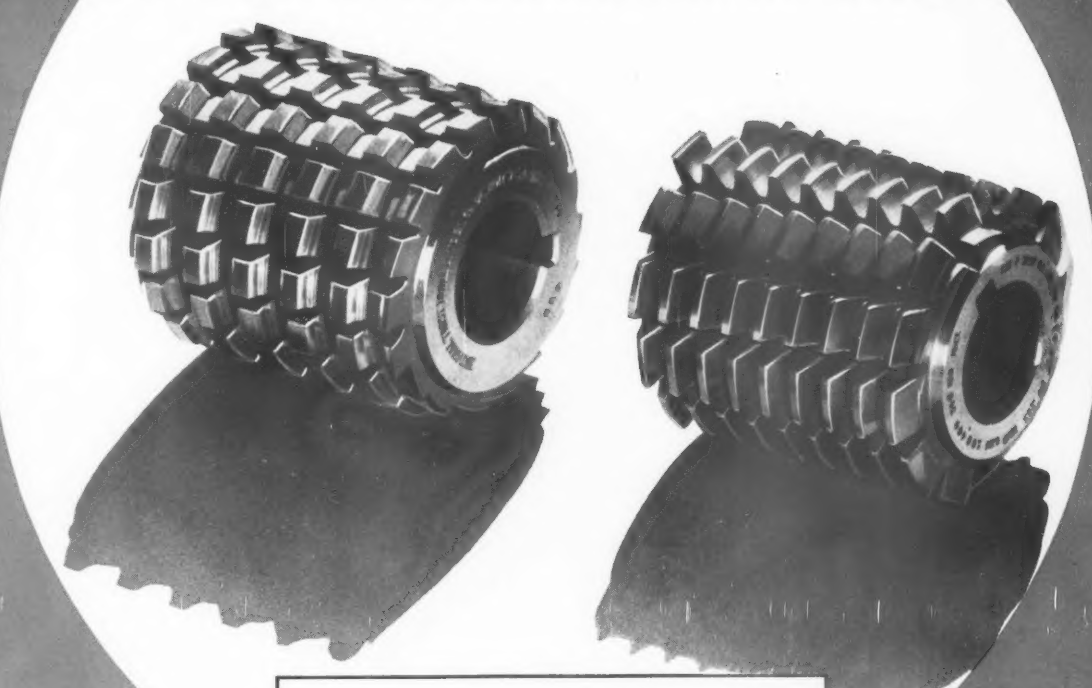
Say, I like that guy E.W.P. Smith, who is consulting engineer for The Lincoln Electric Company down in Cleveland. Boy, did he rip that article, "Cast Iron vs. Fabricated Steel" to pieces. Well, the author of the article asked for it. Come again, Mr. Smith.

▼ ▼ ▼

You should hear the Plymouth Quartette sing: "Dot iss vot I learned in school." I'll tell you how it goes when I see you. H. A.

NATIONAL

HOBS FOR ACCURACY *and* LONG LIFE



For continuous duplication of accurate profiles—to the last tenth—or the gruelling duty of "hogging" out stock in roughing cuts, NATIONAL Hobs will give you more pieces per dollar.

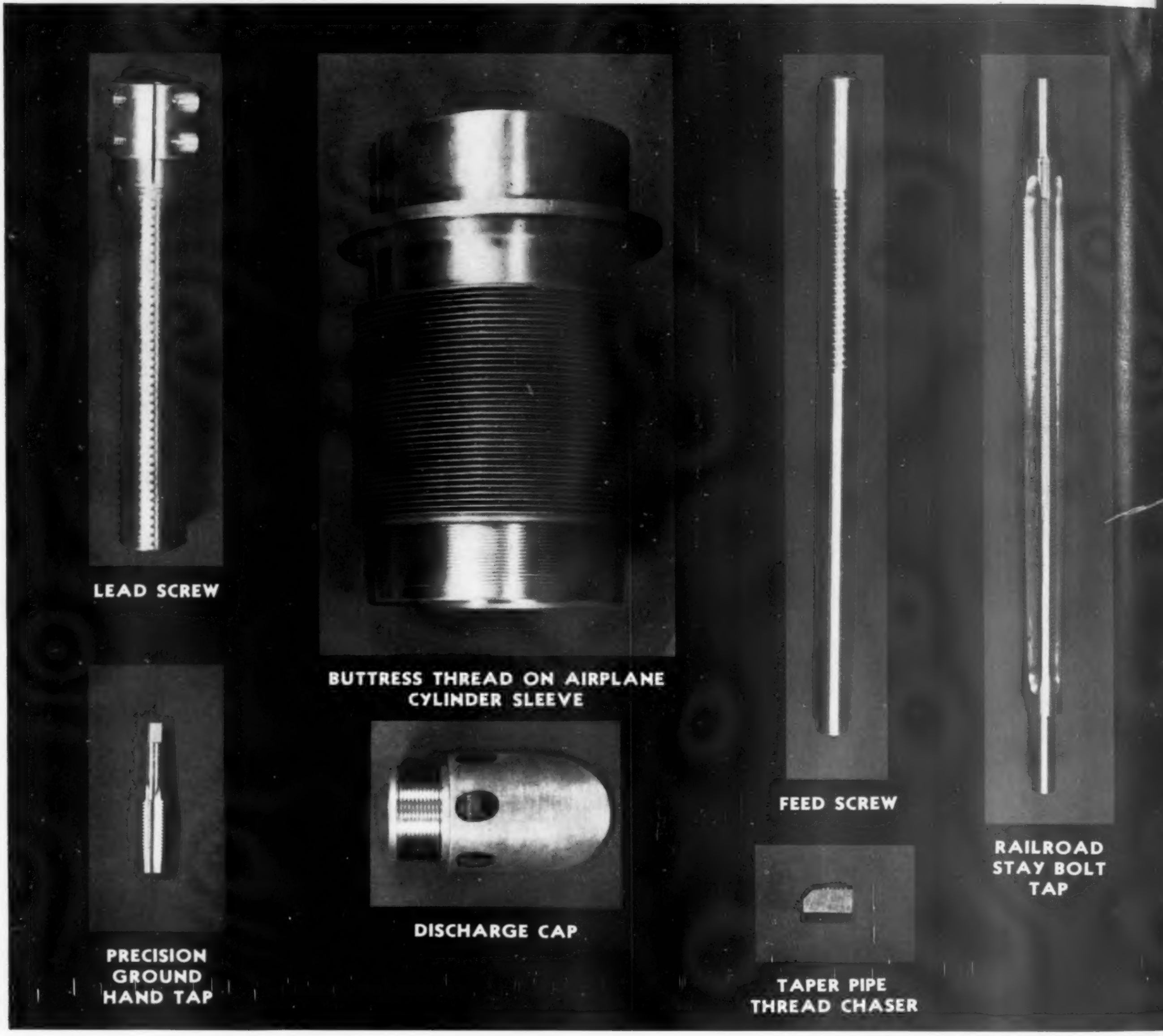
TWIST DRILLS
REAMERS
HOBS

MILLING CUTTERS
SPECIAL
TOOLS

NATIONAL
TWIST DRILL
& TOOL
DETROIT U.S.A.

NATIONAL TWIST DRILL AND TOOL COMPANY
DETROIT, U. S. A.

NEW YORK • CHICAGO • PHILADELPHIA • CLEVELAND
Tap and Die Division, Winter Bros. Co., Wrentham, Mass.
DISTRIBUTORS IN PRINCIPAL CITIES



For Complete Coverage of ALL Thread Grinding Needs

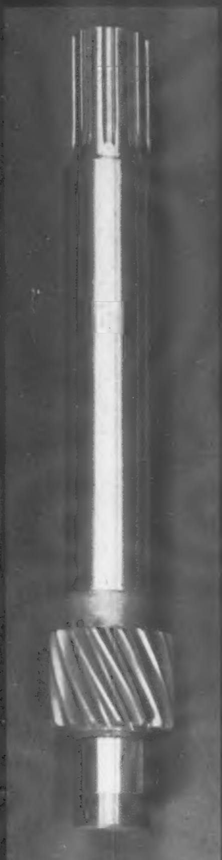
THE machine components and tools, illustrated above, clearly show the flexibility of the J&L Automatic Thread Grinding Machine. The standard machine will grind right- and left-hand threads from 2 to 48 pitch inclusive; threads with single, double, triple, quadruple, or sextuple lead; and from the solid or previously roughed threads.

With standard attachments the machine also will grind relief on taps and hobs, and jump flutes such as on inserted-blade taps. A hob grinding attachment permits grinding thread hobs without lead.

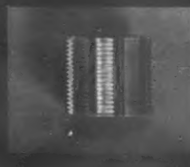
The J&L Automatic Thread Grinding Machine is designed for single piece or small lot runs, as well as for continuous production, where all the automatic features may be used to full advantage.

Send in your drawings or samples. There is no obligation, of course.

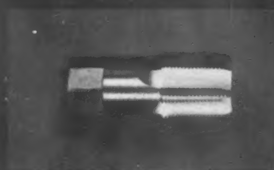
JONES & LAMSON MACHINE



TRANSMISSION SHAFT



THREAD HOB WITHOUT LEAD



TAPER PIPE TAP

PLUG THREAD GAGE

A MACHINE WITH A BACKGROUND OF 18 YEARS OF THREAD GRINDING EXPERIENCE

▪

AUTOMATIC WHEEL TRUEING AND WORK SIZING

▪

NO COMPENSATIONS FOR LEAD ERROR OR WHEEL FORM ARE NEEDED WHEN CHANGING FROM STRAIGHT TO TAPER THREADS

SEND FOR NEW ILLUSTRATED BOOKLET

J&L AUTOMATIC THREAD GRINDING MACHINE

COMPANY, Springfield, Vermont, U. S. A.

THIS MONTH'S COVER

NEW DUPLEX GEAR FINISHER ANNOUNCED

Provides Lower Tool Costs on Short Runs

Designed to meet gear finishing requirements of manufacturers who do not have sufficiently long production runs to take full advantage of the long tool life, lowest possible tooling cost per piece, and minimum production time of the rack type of Michigan gear finisher, a new two-cutter, crossed axis, rotary machine has been placed on the market by Michigan Tool Company.

It offers to the smaller gear producer or one who is faced with the problem of producing a large variety of only a few gears each, a lower initial machine cost and lower initial tooling cost. The sturdy construction permits fast cutting with maximum accuracy by minimizing deflection.

In this Duplex finisher the gears are mounted between centers and are passed between two crossed-axis cutters toward the rear of the machine during the working stroke.

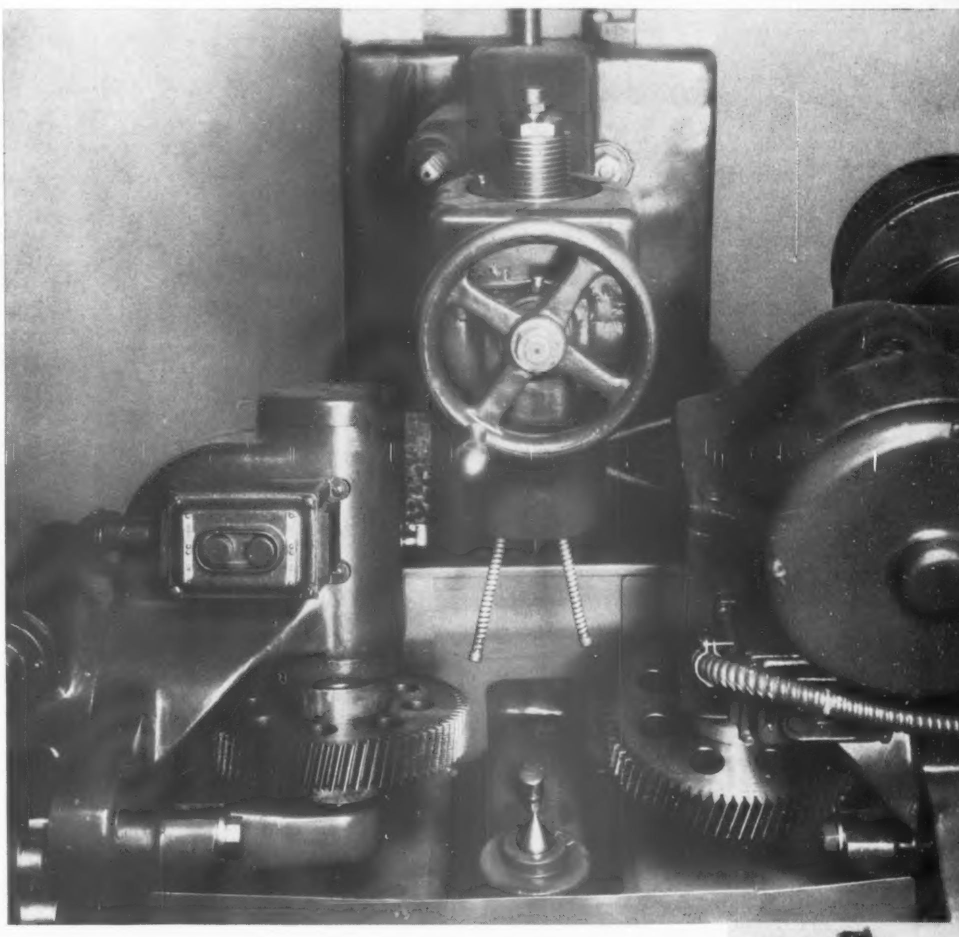
A feature of the machine is that the two cutters can be used independently to finish simultaneously two gears of different characteristics in a cluster or both right and left hand sides of a herringbone gear, thus eliminating duplicate machines and cutting loading and cutting time in half.

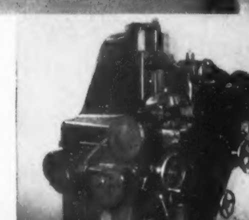
This is made possible by making the two cutters separately adjustable as to height, position with reference to axis of gears, and amount of crossed axis setting. As shown in the detail view, cutters are set to cut a single helical gear.

The crossed-axis setting results, as in the rack type of machine, in creating a sliding action lengthwise of the teeth as the cutter and work are rotated with the cutter and work teeth in mesh. Graduations in degrees are provided on the cutter carrying heads for adjustment of amount of crossed axis desired, or measuring pins may be supplied for this setting.

At the time of loading the work into the machine, the work carrying centers are toward the operator with respect to the cutters. Feed is obtained by moving the work carrying head away from the operator toward the rear of the machine. It will be apparent that when the center of the work is in line with the centers of the cutters the gear will be finished to size.

Feed is by individual motor drive through reduction gears or rapid return may be obtained by provision of separate motor drive, so that working or return stroke speeds can be readily varied by changing pick-off gears.





Above: Detail of the new Michigan Duplex Gear Finisher showing two cutters which can be set to finish two different gears of a cluster simultaneously.

At Right: General view of the Michigan Duplex Gear Finisher showing the sturdy construction. The machine is notable for its extreme flexibility and adaptability to every type of gear-cutting job.

Production Perspectives

(Continued from page 10)

dustrial plant December 18 with the formal dedication of **Chevrolet's new commercial body factory** at Henry Street and White River Parkway.

Civic, business, and industrial leaders of the city joined in the ceremonies which officially opened the new plant. Officials of General Motors and Chevrolet, led by **W. S. Knudsen,** General Motors executive vice-president, and M. E. Coyle, general manager of the Chevrolet division, General Motors Corporation, were the guests of honor.

Work on the new factory **was started a year ago and was completed without the loss of a single day's production in one of the most unusual industrial construction operations on record.** The new building literally swallowed the old as construction proceeded, unit by unit. As each new portion of the new factory was completed, a department was moved in from the old structure. The part of the original plant assigned to that particular operation then was torn down to make way for another section of the new plant.

As the old buildings, of which there were half a dozen, were vacated, department by department, conveyor lines were kept running under temporary cover until they could be located in their new home. Portable tin roofs were moved around as needed to protect the conveyors.

Chevrolet's new industrial unit, considered to be one of the largest and most modern commercial body plants in the world, **will be capable of producing approximately two thousand bodies a day, officials estimated.** The plant contains nearly three miles of conveyors. There are nearly half a million square feet of floor space. A modern hospital, approved by the Indianapolis Medical Society, has been installed at the plant along with a trained and experienced staff.

The plant will give employment to approximately one thousand four hundred Indianapolis workmen and the commercial car and truck bodies they turn out will mean the purchase by Chevrolet of 45,000 tons of steel this year. **Chevrolet expects to make a minimum of 225,000 commercial cars and trucks during 1937** for domestic consumption alone, insuring sustained employment and a continuous flow of payroll money to Indianapolis throughout the year.

Ohio

From **Cleveland** we hear **Herman H. Lind, general manager of the National Machine Tool Builders' Association, resigned to become executive vice-president of the American Institute of Bolt, Nut & Rivet Manufacturers on January 1.**

The Institute's offices are in the Guardian Building, the Association's at 10525 Carnegie Avenue. Mr. Lind's successor in the association has not been selected. Mr. Lind has been manager of the Machine Tool Association since September, 1932.

Ambrose Swasey, leading citizen of Cleveland and world-famous scientist and engineer, **was 90 years old December 19.** He has spent 55 of those years in Cleveland.

Just back from New York where four major engineering societies of America had presented him with the Hoover medal, one of the coveted prizes of the world of science, Mr. Swasey, leaning back in a chair in his office, reiterated some opinions he has expressed during the last two decades. He believes that the world improves steadily. He prefers to look forward to the future and has no hankering for a return to the "good old days." He has a firm faith in the destiny of America and he believes in the power of religion.

Asked what might be expected of the new 200-inch telescope, he replied, "I can tell you one thing they will not see with it. They will not see over the edge."

Mr. Swasey said that he frequently visits the shops of his company and that he is impressed by the great improvement in machine tools, especially the increased accuracy.

"This has improved all the products made with the aid of machine tools," he said. (Continued on page 32)

NATCO
SOLVES YOUR 'HOLE' PROBLEM

Specialized Way Machines
HOLEUNIT Construction

● Today is an age of specialization. Webster defines "specialization" as "trained or designed in a special manner; particularly" or "For a specific purpose." Yes, this machine was designed for a particular set of operations. It is core drilling one angular hole and drilling three angular holes in a medium sized cast iron cylinder block. It is maintaining a production of 45 cylinder blocks per hour.

● Yet this machine is built of standard NATCO HOLEUNITS . . . standardized machine elements which are flexible and interchangeable.

● NATCO HOLEUNITS are completely self-contained and no connections other than electrical are required. Equipped with semi-automatic hydraulic feed, they will a operate at any angle . . . and may be arranged in groups to perform all the required operations on a casting with a single handling. Should the part for which the units are arranged be altered or discontinued, it is only necessary to rearrange the units, equip them with new spindle boxes and the machine may be used for an entirely different piece of work.

● NATCO HOLEUNITS are built in a variety of sizes and capacities . . . and they make possible the building of highly specialized drilling and boring machines at a very minimum of capital outlay. Call, wire or write for a NATCO representative today. They will be glad to make a study of your drilling, boring and tapping problems. Without any sort of an obligation on your part they will make a careful survey and lay their recommendations before you.

Chicago Office, 2009 Engineering Bldg.
Detroit Office, 409 New Center Bldg.

THE NATIONAL AUTOMATIC TOOL CO.
Richmond, Indiana, U.S.A.

Reduce Production Costs! Investigate Today

NATCO
Drilling, Boring and Tapping Machines

✶ LETTERS ✶

The Lincoln Electric Co.
Cleveland, O.

Mr. Roy T. Bramson, Editor
2842 West Grand Boulevard
Detroit, Michigan

My Dear Mr. Bramson:—

In the Tool Engineering for November, 1936, on page 17 there is an article entitled "Cast Iron or Fabricated Steel—WHICH?" by Mr. A. E. Rylander.

Mr. Rylander raises several points of discussion. First of all, there is a matter of grace. Welded construction permits allocation of parts and their assembly without limitations, such as exist in the case of patterns and castings and consequently it is a matter of proportioning in order to obtain the desired grace of appearance. This matter of proportioning is so easily obtained by welded construction that any machine may be constructed with an exceedingly pleasing appearance.

Secondly, the question of solidness. Perhaps a long "I" beam on a truck is visualized and this appears to be very flexible, whereas as a matter of fact it is several times stiffer than the cast iron for the same cross section. Due to the fact that there is a great freedom in design in welded construction, the metal may be so placed that for a much less weight of material it is just as solid as the casting, this of course being due to the superior stiffness of the steel.

In the third item, the matter of ribbing cast iron has offered an opportunity for a lengthy discussion of the superiorities of welded steel construction. It may be summarized in stating that there are no limitations as to the location of the metal. Only so much metal as is needed and no more can be placed in the position required by the design. Due to the fact of the inherent superior qualities of the steel, less metal is used and consequently the design is inherently less in weight then the casting.

In fabricating welded construction, it is customary to work to closer limits than is possible with castings, consequently the machining costs in general are less than for cast iron.

Alterations are not easily made with a casting. Welded construction permits the placing of metal as mentioned above with the greatest possible advantage. Being fabricated by welding it is easy to make changes. The changes involve merely instructions in the way of a change on a drawing instead of change on a drawing and on a pattern and eventually in the casting.

I am surprised that Mr. Rylander mentions that patterns are used year after year, merely with slight changes, when progress is being so rapidly made in design. Mr. Rylander admits that welding has progressed tremendously since the time he mentions, more so perhaps than has pattern and foundry practice. He concedes the advantages of steel under certain conditions of quick production, limited time. I cannot agree, however, where he states that extreme accuracy is not essential because in most specifications the accuracy required in welded construction is very much greater than that required in a corresponding cast construction.

In the matter of stresses in the metal to be used, steel is vastly superior to cast iron, both in fatigue and the other stresses. Mr. Rylander seems to emphasize throughout his discussion the question of appearance, saying that the engineers who combine artistry with practice can work wonders with steel. He forgets entirely the reason for the fabrication of the particular machine involved, such as service life and cost. A machine is fabricated for a very definite purpose—to do a certain definite job. This must be done, first of all, with a low first cost and second, it must have a long service life. Adequate service life at low cost is necessary if the user of the equipment is to stay in business.

This has been very graphically illustrated in the case of a large manufacturing plant where they have a great number of machines constructed of castings. As these castings fail they are replaced by steel. Seeing one of these castings which looked in pretty good shape, the suggestion was made that it might be welded. The answer was that it could be welded, but there was no assurance that the service life would be adequate, whereas if the steel construction were used the service life would be adequate and they could forget that particular equipment insofar as replacement was concerned; otherwise, considering the usual question of obsolescence. It is also interesting to note that these steel fabricated parts are made at a less cost than the price of a casting and that the pattern costs are not included in this price of the casting.

The flexibility of design and freedom from inherent limitations which exist in the case of welded fabrication permit the designer to

(Continued on page 40)

The Barber-Colman Taper Spline

A New Method of Mounting Machine Members on Shaft-Ends

Until recently there has been no really good method of mounting machine members on shaft-ends. A square key was not always strong enough, a semi-circular key weakened the shaft. Multiple keys of either type,solid square shaft-ends, and other shapes, increase production-cost and fitting expense. To provide a better,

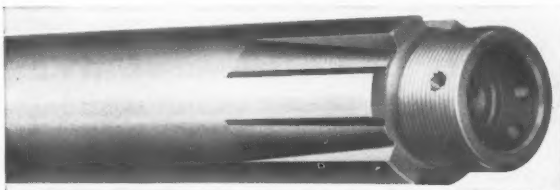


Fig. 1—Shaft with Barber-Colman Taper Spline

stronger, more accurate, more reliable and durable means, for this purpose Barber-Colman engineers developed the Taper Spline shown in Fig. 1. This provides multiple integral keys, greater strength and contact area, greater accuracy, and solid metal-to-metal seating on the tapered surfaces between the keys.

To produce this shaft-end economically it was necessary merely to develop a suitable hob and to provide means for traversing it diagonally across the work-piece as the hob advanced into its cut. A typical taper

Fig. 2—Typical Taper Spline Hob

spline hob is shown in Fig. 2. The longest teeth on the hob take out the metal between keys at the end of the shaft and less and less metal is removed as the operation progresses until the cut runs out as the taper between keys is completed.

To secure the diagonal traverse of the hob across the work-piece; the Barber-Colman Type T Hobbing Machine, shown in Fig. 3, was designed. The hob slide swivel in this machine has an additional feed screw to traverse the hob diagonally across the work-piece, and special micrometer dials on the work slide and main feed screw to facilitate locating these members accurately for loading. In other respects the Type T Hobbing Machine is similar to preceding Barber-Colman Hobbing Machines and it can be used for all kinds of standard hobbing when not employed on taper spline shafts. By using the hobbing process as indi-

Fig. 3—Type T Hobbing Machine

cated, highly accurate taper spline shafts are produced in large quantities most economically.

The hub or mating part for the Barber-Colman Taper Spline also can be produced rapidly and economically by simple standard manufacturing processes. It is necessary only to bore or ream a hole having a taper corresponding to that of the shaft between keys and then pull or push through a suitable straight multiple spline broach.

The test piece shown in Fig. 4 duplicates a universal joint drive that had a torque capacity of about 50,000 inch-pounds with ordinary construction. The test piece, with Barber-Colman Taper Spline, carried the maximum load of a testing machine at 232,000 inch-pounds without distortion or signs of failure. As a result of such outstanding performance, the Barber-Colman Taper Spline is being generally accepted by industry particularly among tractor manufacturers.

Fig. 4—Taper Spline Test Piece

In Detroit and vicinity complete information about the Barber-Colman Taper Spline and Type T Hobbing Machine can be obtained from Hodges Machinery Co., 544 New Center Building. Elsewhere, information can be secured from local representatives of the Barber-Colman Company or by writing to the general office and plant at Rockford, Illinois.

Production Perspectives

(Continued from page 28)

A **$25,000 addition** to the Cleveland plant of the **American Steel Foundry Company** of Chicago—the **Cleveland Production Company,** at 2112 W. 106th Street—was started in December.

The local plant, **headed by J. W. Jackson,** manufactures wheels for railroad cars. Need for increased production necessitates the building of this one-story addition. The building will cost around $12,000 and the added equipment $13,000.

One of the greatest single steps in Cleveland's industrial expansion came with the announcement of Tom M. Girdler, president of the Republic Steel Corporation, on the start of construction on a new $15,000,000 hot and cold continuous strip mill in the Cuyahoga Valley.

Contracts for machinery have been let to the United Engineering Company of Pittsburgh and Youngstown. Work on the gigantic new plants has started. The new mills, comprising nine separate buildings, will be located on a 120-acre site bounded by the Wheeling & Lake Erie Railroad, the Newburg and South Shore Railroad, and Harvard Avenue. The main entrance will be on Harvard Avenue, just east of the Harvard-Denison Bridge.

When completed, **the mills will have a capacity of between 60,000 and 70,000 tons of strip steel a month.** Running at capacity, **the mills will employ 2,200 men.**

Apex Electrical & Manufacturing Company eliminated a sizable accumulation of back preferred dividends last year, **purchased the Holland-Rieger Company** at **Sandusky, and also bought eighteen acres in the opposite side of Sandusky,** which includes the former Maibohm Motor plant.

Engineers of the B. F. Goodrich Company have developed a solid rubber endless traction belt for track-laying vehicles. J. D. Tew, president of Goodrich, sees in this rubber track a new impetus to the tractor manufacturing industry which had a production volume last year approaching $150,000,000.

▼ ▼ ▼

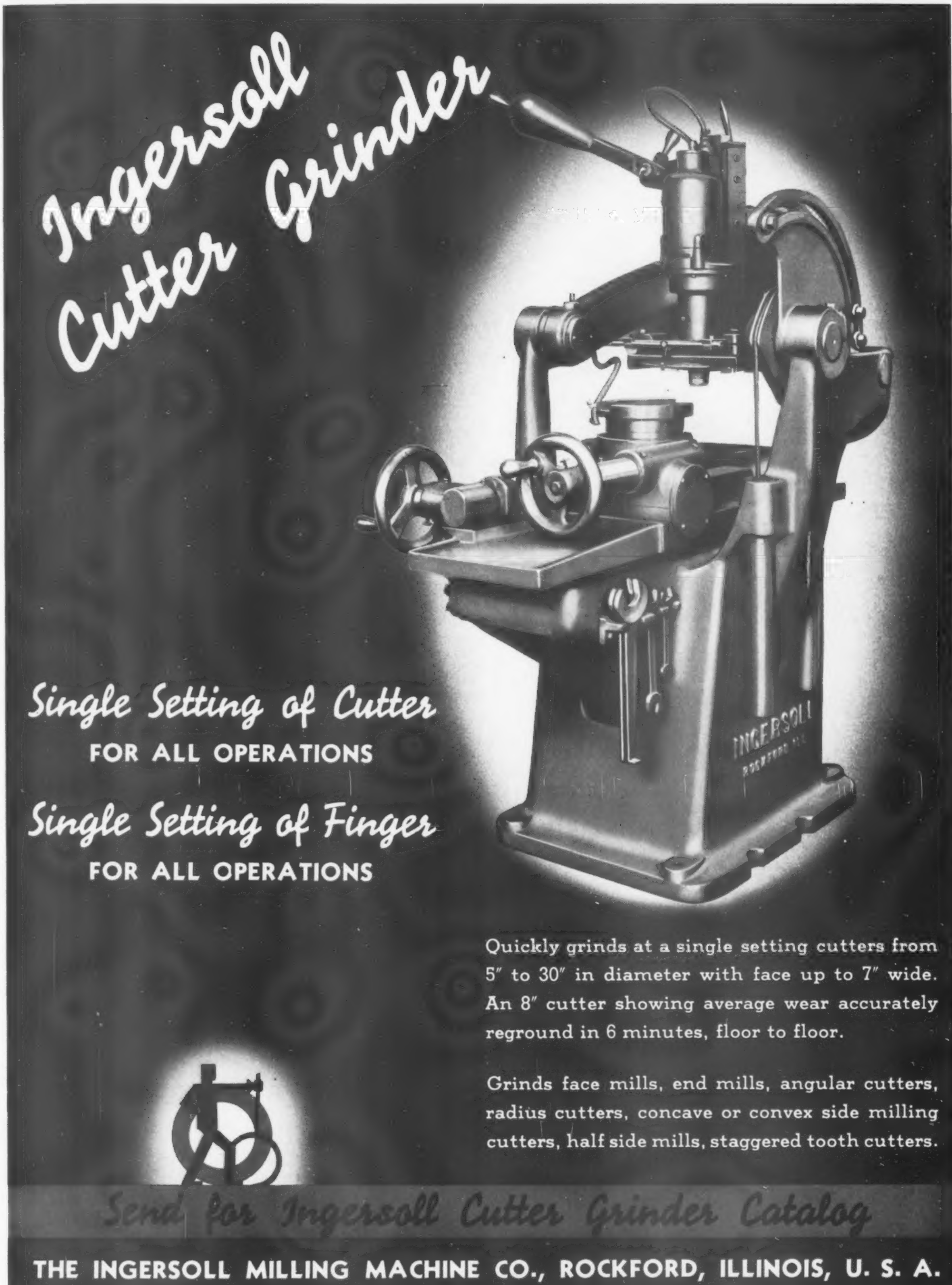
The Morrison Machine Products Company, Elmira, New York, started construction of its **new machinery plant** there in mid-December, officials stating equipment will be installed in time to start operations about the middle of February. The building, providing 12,000 square feet of manufacturing space, is being erected at a cost of about $50,000.

▼ ▼ ▼

Well known in central New York as a manufacturer of tools, and head of the company which bore his name for the past 39 years, **Charles J. B. Borgeson died** suddenly **at his home in Syracuse, New York,** recently at the age of 68 years. Coming to that city 44 years ago, Mr. Borgeson established a tool-making shop there five years later, and he was actively in charge of the business until a day or two before his death. Funeral services were held in Syracuse, with burial in Woodlawn Cemetery in that city.

Elected to National Board

W. J. Fors and F. M. Gertiser have been elected by letter ballot dated November 3 by Board of Directors to fill the vacancy of Robert Lindgren and F. J. Morisette who resigned as Board of Directors for 1936-1937.


Ingersoll Cutter Grinder
INGERSOLL
Single Setting of Cutter
FOR ALL OPERATIONS
Single Setting of Finger
FOR ALL OPERATIONS
Quickly grinds at a single setting cutters from 5″ to 30″ in diameter with face up to 7″ wide. An 8″ cutter showing average wear accurately reground in 6 minutes, floor to floor.
Grinds face mills, end mills, angular cutters, radius cutters, concave or convex side milling cutters, half side mills, staggered tooth cutters.
Send for Ingersoll Cutter Grinder Catalog
THE INGERSOLL MILLING MACHINE CO., ROCKFORD, ILLINOIS, U. S. A.

TRY-OUTS

"I came across a statement the other day to the effect that if all the after-dinner speakers in the United States were placed end to end how nice that would be. And that shows you what a dangerous business this is of making speeches when people get ideas like that in their minds. Of course, all professions are more or less dangerous. Ed Wynn says that bridge players live for years and years but crap shooters go like that (snapping the fingers) . . . Now, I don't know anything about the Tool Engineering business but you probably have your troubles. I learned something about Homer (Bayliss) this evening. Your chairman said he was full of inertia. I always knew he was full of something but I never knew what it was before . . .

"I was over to a Banker's dinner in Chicago the other night and there was a banker making a speech trying to prove that banking is a respectable business. Now you know, I really shouldn't say that. I have a lot of sympathy for the bankers these days—God's frozen people. I have a banker at home. I go in and talk to him now and then. I had a conversation with him the other day. He said, 'No' . . . Joseph was a very great business man. He doped out the market seven years ahead without the aid of Babson. He did it by means of a dream book. It is still being used in Wall Street. Noah was a very great business man. He floated a company while the rest of the world was in liquidation. He had all his friends take stock in the Ark and made it posssible for us to have radiator caps . . .

"Of all the human beings in the world there have never yet been two exactly alike in every way. And yet, different as we all are there are some things we have in common and one of them is the powerful emotion which we call fear. And as fear has so much to do with our lives, so much to do with happiness or unhappiness, success or failure, it is interesting to set down some of the things that men are afraid of. There are five things we are all afraid of: 1. Fear of accident and disease. 2. Fear of loss. 3 Fear of displeasure of the Group. 4. Fear of failure. 5. Fear of the unknown.

"I gave this list to one man and he said I had forgotten one of the things men were afraid of. And I said, 'What is that?' And he said, 'Some men are afraid of their wives.' There was a man who drank a good deal and his wife had tried to break him of the habit. She had tried everything and finally someone suggested that she try kindness. So he came home late one night and she received him at the door cordially, which had not been her custom, and helped him off with his coat and put on his slippers. Then she sat on the arm of his chair and ran her fingers through his hair, and said, 'How do you feel now?' And he said, 'I feel fine but if my wife ever finds out I've been here with you she'll raise hell with me.' . . .

"As somone has said, this world is a dangerous place to live in and few of us get out of it alive. We are afraid of the things that mutilate the body. There are new kinds of accidents coming along all the time. There were three children, one five, one three and one—one year old, and they were deciding what they would do if they had their lives to

(Continued on page 36)

Try-Outs

(Continued from page 34)

live over again. The five-year-old said he would cut out spinach, and the three-year-old said he wouldn't go to bed early because you lose so much time that way. And the one-year-old said, 'If I had my life to live over again I would be a bottle baby because it is such a nuisance getting cigarette ashes in your eyes when you are eating.'

"So, there are new hazards coming along all the time. There was the lady nudist who went up to the head nudist in the colonoy and said, 'I thought this was a nudist camp.' And the head nudist said, 'It is a nudist camp.' And the lady said, 'Well, I have a complaint to make. There is a man over there with a blue serge suit on.' And the head nudist said, 'No, lady, that is not a blue serge suit. That poor guy is just freezing to death.'

"Now, one of the reasons why we are afraid of accident is that we live in a machine age. On every side we are surrounded by these creatures of our own construction and they are very dangerous. We know that, so we have this fear. We have built up this wonderful safety movement. Take the automobile for example. Half the babies you see nowadays cut their teeth on a Ford steering wheel. A man said to his friend, 'Do you drive a car?' And he answered, 'No, I steer one but my wife drives.' The machine age even influences our language. A baldheaded man went into a barber shop and the barber said, 'The best I can do for that head is to Simonize it.'

Editor's Note: Again we have quoted, in the above, extracts from a very entertaining address by Charles M. Newcomb, delivered before a Detroit meeting of the A.S.T.E. last April. Readers are invited to contribute their "bits" to the "lighter vien in Tool Engineering" for publication in this column from time to time.

Gears for Machine Tools

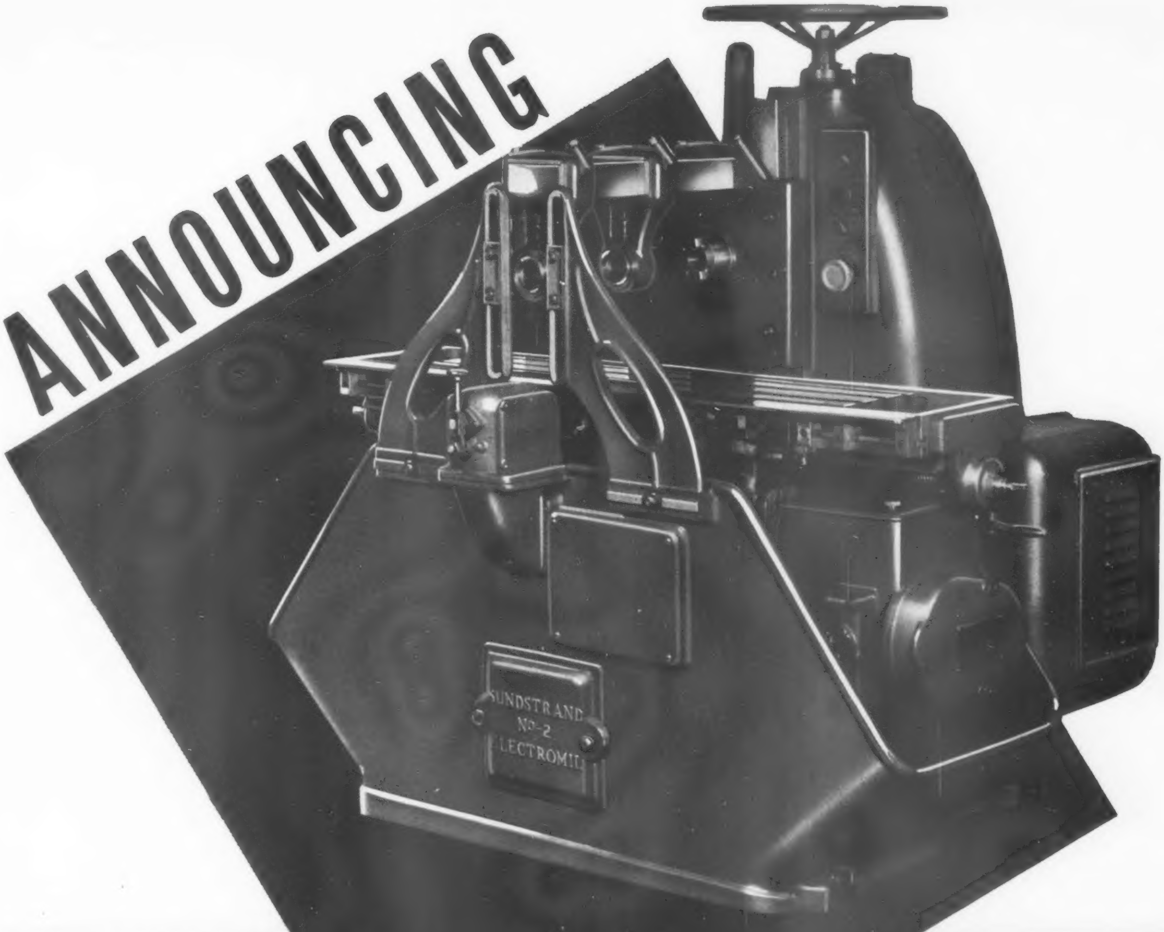
(Continued from page 11)

used and also the methods of cutting, but before we determine which process to use, we have the limitations and the requirements of the design to consider in detail. With the wide range of speeds and feeds now used, there are generally several gears in mesh at every speed, and as space is limited, this calls for the best material because of the narrow faces required and for ball bearings and splined shafts. At this point, the procedure as to the method of cutting to be used is determined from the known or assumed requirements of the gears.

It is often noticeable that as gears for one type of machine are improved by more advanced methods of machining, machines of another type that have always been considered satisfactory immediately stand out, and then the demand to use the more refined methods on this other type becomes imperative.

It would be fair to admit that the great advance in gear manufacture of recent years has been due largely to the automobile industry in conjunction with the manufacturers of gear cutting equipment; the mass production of the automobile industry permitting expensive developments to become commonplace so that everyone can profit by them. Also, credit must be given to the press which has made available the many outstanding papers on gear technique and manufacture that have been written and presented before the engineering societies and trade associations; these papers making everyone interested, familiar with the new ideas and equipment as soon as presented.

ANNOUNCING



The Sundstrand Automatic No. 2 ELECTROMIL

Send for this
CIRCULAR

New illustrated circular containing comple'e information on the No. 2 Electromil; including features, advantages, set-ups, cycles and specifications; will be mailed postpaid promptly on request. Write, today, for a copy.

A small Rigidmil with complete electrical control. For high-speed operation on parts of adding machines, typewriters, sewing machines, household appliances, electrical apparatus, firearms, small machine parts, tools, and similar products. The No. 2 Electromil is lightning fast, highly accurate, extremely adaptable, easily set-up for a wide variety of cycles. Will "climb cut" or conventional mill separately or in combination. Has excellent possibilities for increasing production and cutting costs on all work within its capacity. Investigate. Write today for details.

SUNDSTRAND MACHINE TOOL CO.
2532 Eleventh Street, ROCKFORD, ILLINOIS

RIGIDMILS - STUB LATHES
3-Wheel Tool Grinders - Centering Machines
Hydraulic Operating Equipment - Special Machinery

SUNDSTRAND MACHINE TOOL CO. S ROCKFORD ILLINOIS U.S.A.

"LOGAN"

NON-ROTATING AIR CYLINDERS

A COMPLETE LINE OF

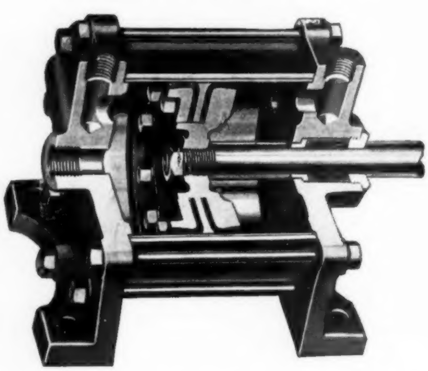
- AIR-HYDRAULIC POWER DEVICES
- AIR-HYDRAULIC CHUCKS
- AIR-HYDRAULIC CYLINDERS
- AIR-HYDRAULIC VALVES

Detroit Representative
AMERICAN EQUIPT. CO.
5929 Second Blvd.
DETROIT, MICHIGAN

Chicago Representative
R. E. ELLIS ENG. CO.
621 Washington Blvd.
CHICAGO, ILL.

Cleveland Representative
CLEVELAND DUPLEX MACHINERY CO., INC.
Penton Bldg.
CLEVELAND, OHIO

Sectional view, showing Logan exclusive features. Self adjusted by air composition packings; steel, brass lined, tubing; sea ring self adjusting piston rod packings; piston rod bronze support guide.



Logan non-rotating, double-acting air cylinders are made in eight standard models, each model being furnished in all standard sizes from 1½" diameter up. All cylinders up to and including 8" diameter are made from steel, brass lined, tubing. All models are furnished with adjustable cushioning features. These cylinders are suitable for all industrial applications. Write for complete information.

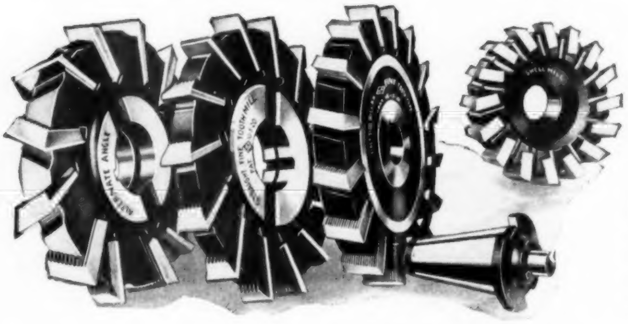
LOGANSPORT MACHINE INC., LOGANSPORT, IND.

THE SERRATED BLADE ADJUSTMENT

USED IN O. K. SINGLE POINT TOOLS & MILLING CUTTERS

Will Step Up Production and Step Down Costs

The bodies of O. K. Single Point Tools and Milling Cutters are made of tough, alloy steel, heat treated for maximum strength; the blades are of drop-forged, high-speed steel, specially heat treated for long-service cutting. Only the part that does the actual cutting is made of the more expensive steel. The result is a distinct saving in tool cost, also a noticeable step-up in production speed, due to the more efficient, convenient type of construction.



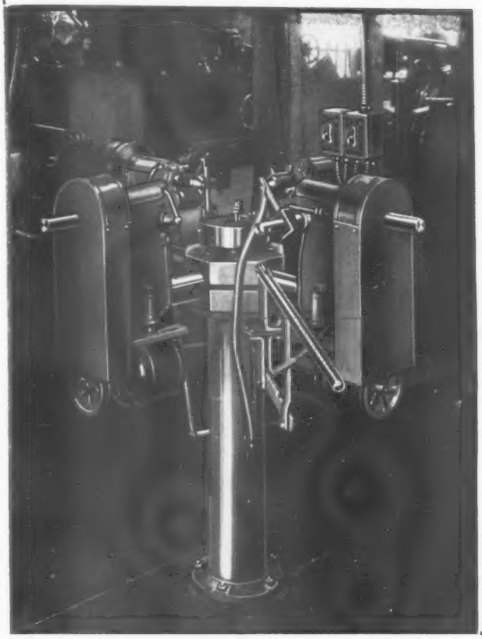
O. K. ECONOMIES CAN BE PROVED!

If you are using cutters and tools of the solid type, we would welcome a chance to send a representative to confer with you about making a demonstration in your plant, without any obligation to you. In the meantime, may we send you more details about the O. K. System?

THE O. K. TOOL CO., SHELTON, CONN.

THE [TRADE OK MARK] SYSTEM OF INSERTED-BLADE METAL CUTTING TOOLS

HOW "DELTA" DRILL PRESS HEADS SAVE MONEY FOR YOU . . .



Here's a case in point. The photo shows a four-way drilling machine built by a Western piston manufacturing company for drilling oil-relief holes. Standard Delta 14" drill-press heads are used. Two, three or four heads can be used, as the relief-hole drilling operation requires, and pistons from 2¼" to 5½" diameter can be drilled without moving the heads, due to the long quill stroke (4").

The point is that the machine was constructed at a cost of less than $250, including the drill-press heads and motors, and this, as the company states, is only a fraction of the cost of a special machine built in the ordinary way for this purpose. And it has a capacity far in excess of requirements at present . . . so nothing was sacrificed to gain economy.

See how Delta drill-press heads will fit into your next special drilling operation. And investigate the possibilities for the low-cost, accurately built 14" and 17" Delta drill Presses in your shop and tool room. Heads for 17" drill press can also be used separately for special setups. Write for complete details of Delta Drill Presses.

Men who know tools say this is the greatest drill press value ever offered. Get the full story.

DELTA MFG. CO.

619 E. Vienna Ave. Milwaukee, Wis.

Dynamic Balance

RIVETT attains real precision for the enclosed bench lathe with "Dynamic Balance" of every rotating part. Spindles are rigid and vibrationless at all speeds. Other standard characteristics for lasting precision are: maximum slide areas, three-point mounting and slide rest shoe which always squares with center line. Operating features of value are: splash lubricated speedbox drive, standard constant speed motor giving 18 spindle speeds, replacement of driving belts without disassembly of spindle or removal of head, and hinged cover to permit turning of spindle by hand.

RIVETT LATHE & GRINDER INC.

BRIGHTON, MASS., U. S. A.

Production Lapping Gears

(Continued from page 13)

ing contact between lap and work, a greater relative difference must be made between the rotating and reciprocating speeds to accomplish the desired results.

The internal gear-type lap can within certain limitations also be used for lapping helical gears. It is not, however, generally recommended to use this type of lap for helix angles in excess of 30 degrees.

Lapping Improves Contacting Surface on Gear Teeth

Visual proof of the benefits derived from gear lapping have been shown by a "Red Liner" chart. Records of the same gear after finish cutting, heat treatment, and lapping have been transferred to one chart for comparison. Such a chart shows that the lapping operation removes all irregularities due to heat treatment and also improves the working surfaces of the teeth over that obtained in the finish cutting operations. Combined errors do not exceed 0.0005 inch.

The practice of one large automobile manufacturer is to lap the gear two minutes per side or a total lapping time of four minutes per gear. Then the gears are inspected for tooth bearing and noise, and those which do not pass inspection are relapped.

Laps and Lapping Compounds

Laps should be made from a good grade of cast iron and be accurately cut. They are usually made about ¼ inch wider than the face width of the gear they are intended to lap. Grain of abrasive used should be in the vicinity of No. 280 or 360, depending on the amount of lapping required and finish desired. The abrasive should be mixed with a so-called non-fluid oil of high viscosity, but comparatively light body, so as to keep the abrasive in suspension and at the same time flow freely. The compound is automatically kept mixed by an agitator and is pumped to the laps and work.

Letters

(Continued from page 30)

make a machine which is not only good in appearance, but which is built at a low cost and which has adequate service life.

The superiority, therefore, of welded construction must be considered and the designer must not be blind to these advantages, and if he is not blind to these advantages and takes them into consideration, he will make his product by fabricated welded construction.

Yours very truly,

The Lincoln Electric Company
E. W. P. Smith
Consulting Engineer

EWPS:HW

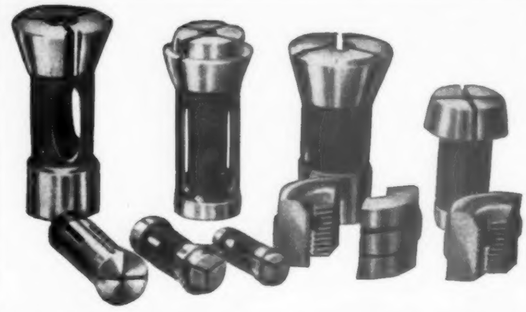
Editor's Note: The writer of the article which provoked this letter is satisfied with the splendid discussion it has started. Other letters on this subject will be printed in this column from time to time.

GAMMONS OF *Manchester*

PRODUCTION TOOLS

ORIGINATORS AND MANUFACTURERS OF HELICAL FLUTED TAPER PIN REAMERS

THE GAMMONS-HOLMAN CO., MANCHESTER, CONNECTICUT



"MODERN" COLLETS

for

Economy Accuracy Long Life

MODERN COLLETS are made of a special steel and have a hard, long-wearing surface with a tough, springy core. They are guaranteed accurate in design, and taper is ground true with the hole. The deeper, better formed corrugations insure positive gripping. Locking fingers and shoes will last longer, and MODERN COLLETS exert far less strain on chucking cam and chucking cam roller pin.

Write for our catalog on feed-fingers, cams, shaving tools and other screw machine parts.

Modern Collet & Machine Company

401 SALLIOTTE ST. ECORSE, MICH.

H. R. KRUEGER & CO.

DETROIT, MICH.

★

Manufacturers of

Multiple Drill Heads

★

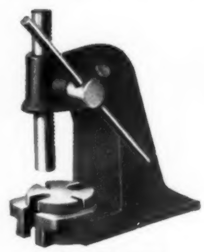
Special High Production Machinery

Exclusive Sales Representatives of

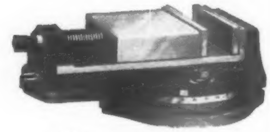
W. F. & JOHN BARNES CO.

Rockford, Illinois

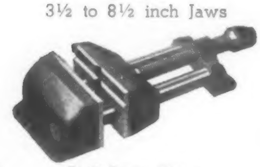
SHELDON ARBOR PRESSES and VISES



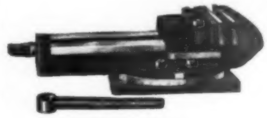
Arbor Presses
12 Sizes
From 3/4 to 10 ton Pressure



Plain and Swivel Milling Machine Vises
4 Sizes
3½ to 8½ inch Jaws



Drill Press Vises
3 Sizes
4½-6½ and 9 inch Jaws



Shaper Vises
2 Sizes
12 and 14 inch Jaws

Ask for No. 25 Catalog and Price List

SHELDON MACHINE CO.

3251 Cottage Grove Ave. Chicago, Ill.

Advertisers' Index